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SCIENTIFIC AMERICAN

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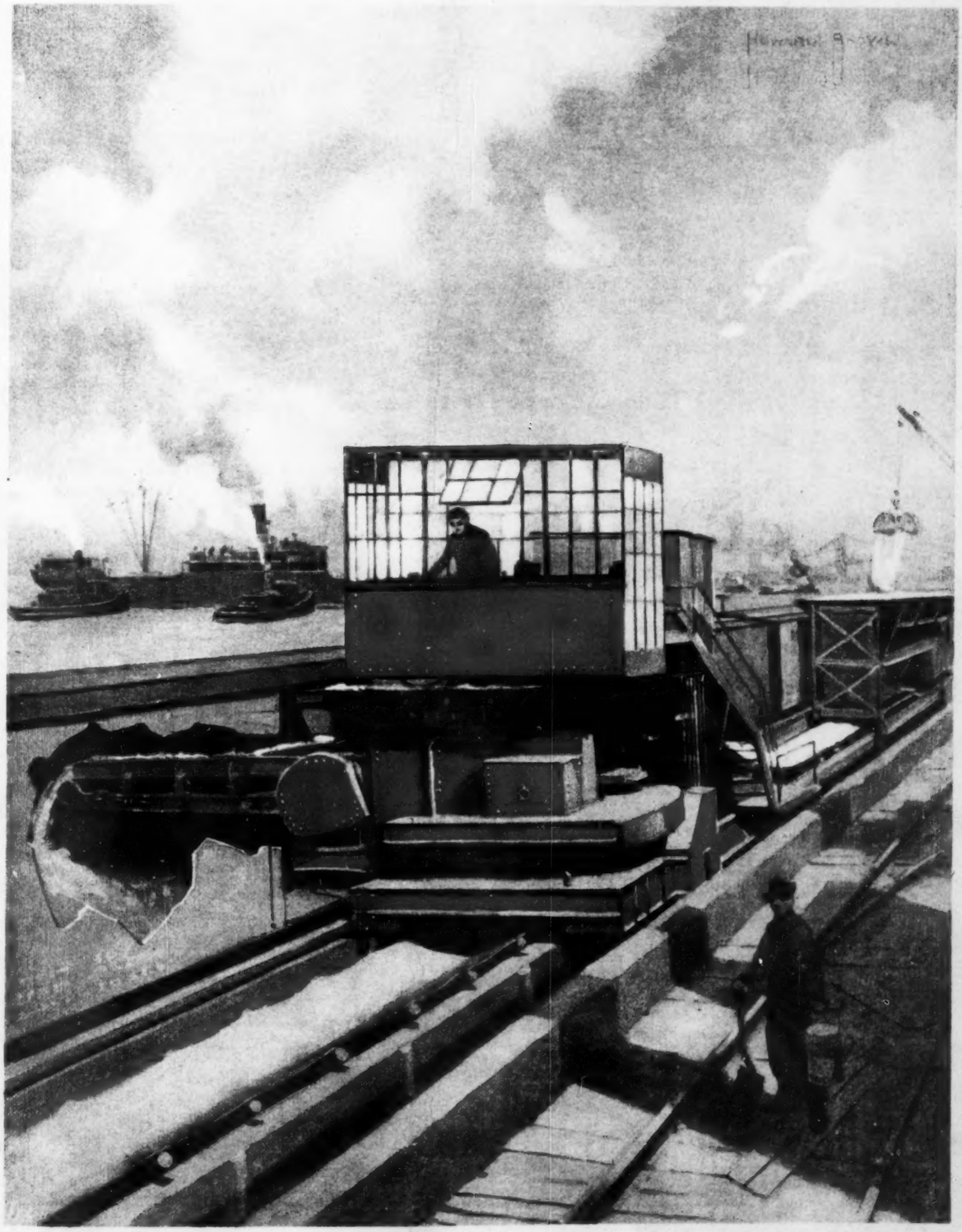

A CAR-LOADING MACHINE WHICH WEIGHS THE MATERIAL AS IT PASSES [See page 495]

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May 10, 1919

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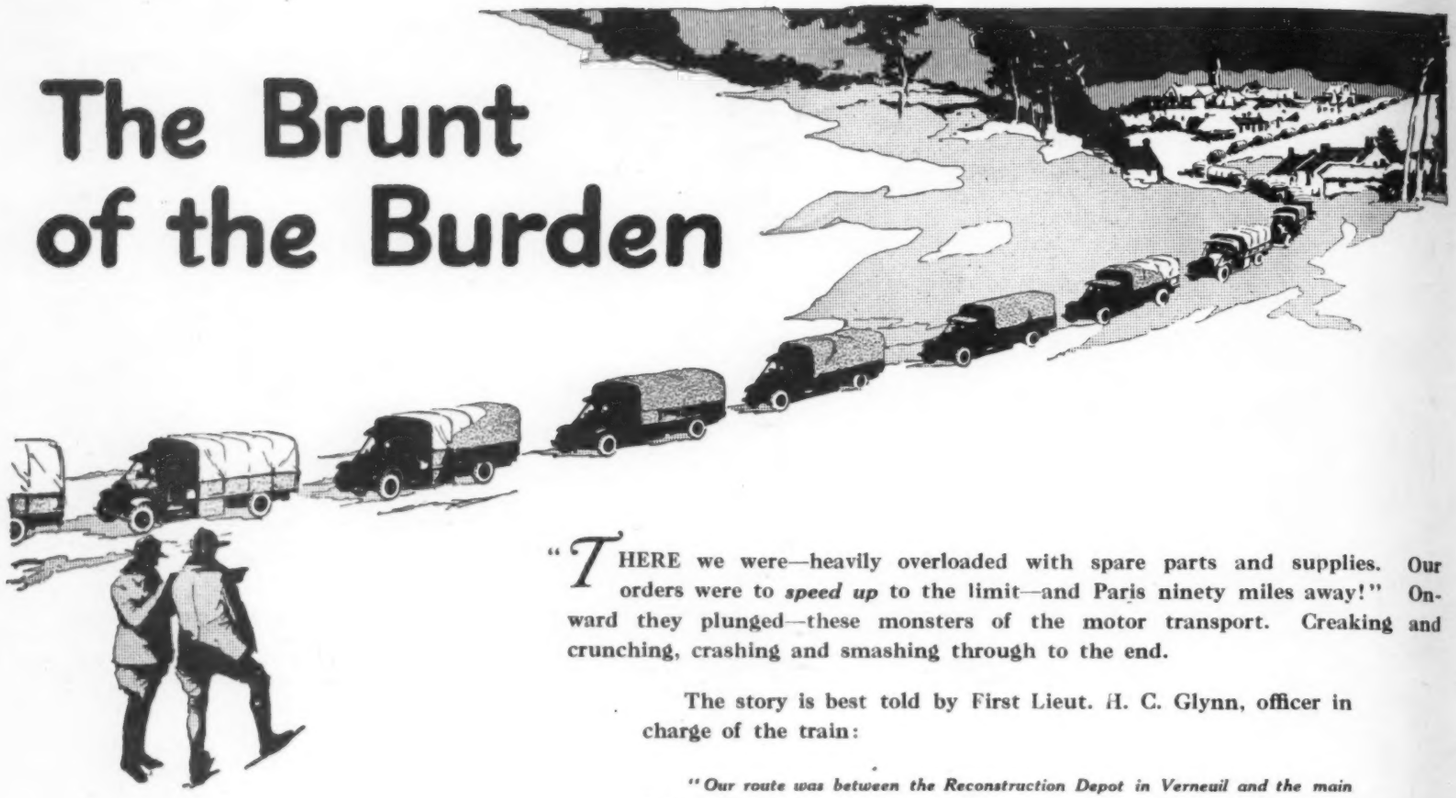
The Brunt of the Burden



"THERE we were—heavily overloaded with spare parts and supplies. Our orders were to ***speed up*** to the limit—and Paris ninety miles away!" Onward they plunged—these monsters of the motor transport. Creaking and crunching, crashing and smashing through to the end.

The story is best told by First Lieut. H. C. Glynn, officer in charge of the train:

"Our route was between the Reconstruction Depot in Verneuil and the main Supply Depot in Paris. We covered the distance four times in three weeks, making 20 and 25 miles an hour, over all kinds of roads in all sorts of weather.

"Thirty-five trucks of my train were fitted all-'round with 'Nobby Cord' tires. They stood the 'gaff' through the entire run—never a single change. This was a most gruelling test of strength and endurance."

That is the ***secret***—the 'Nobby Cord' stands the "gaff." A big, burly, brutish, bull-dog tire with a tread of surly, sturdy "teeth" that grips the road and hangs on for keeps. More life, more wear, more distance—less gas and oil, less depreciation and fewer replacements. Easy on and easy off.

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US
RUBBER SYSTEM
AND ASSOCIATED COMPANIES

'Nobby Cord' for trucks

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AND THE FOREIGN BUILT WATCH

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THE hairspring is the brain of the watch. It is the most delicate tension spring made. For use in the small sized watch, 84,000 springs are made from one pound of steel, raising the value of that pound of steel from $5.00 to $30,000.

The Waltham hairspring steel is drawn through diamond surfaces, and for the smaller watches, to a third of the thickness of a human hair.

The Breguet, or over-coil (named after its inventor, a famous old French watchmaker), is used on every Waltham watch. The most important part of the complete operation in making a hairspring is the forming and tempering of this Breguet over-coil.

At Waltham, instead of being formed or bent by hand as a ***separate*** operation, the entire ***completed*** hairspring is ***formed at one and the same time,*** after which it is hardened and tempered ***in form*** — the invention of John Logan, American watchmaker, a genius who was a part of Waltham leadership in watchmaking. Indeed, Waltham is the only watchmaker that claims this perfect method of making the Breguet hairspring.

The foreign, imported watch movement has a hairspring that is first formed ***in the flat,*** then hardened and tempered ***in the flat.*** Then the outer coil is bent to form the Breguet over-coil, which, if the flat spring were ***as hard as the Waltham,*** and ***properly*** tempered like the Waltham hairspring, it could not be bent to ***correct*** form, and would be liable to break in the attempt.

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WALTHAM

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INCREASE!

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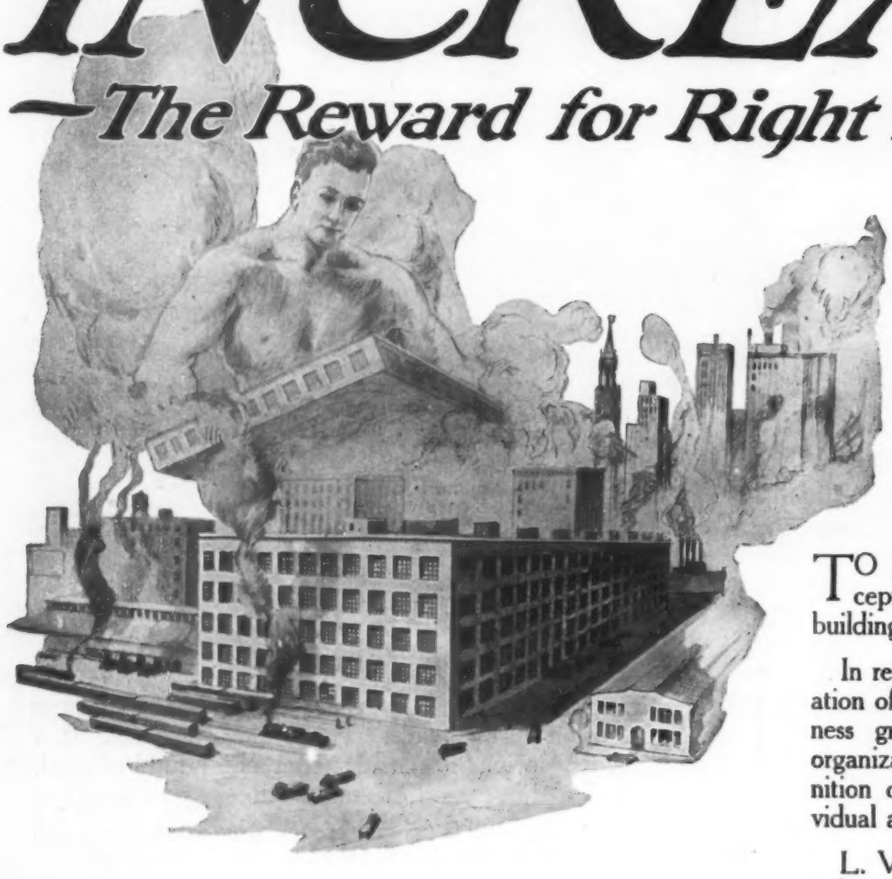

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SEVENTY-FIFTH YEAR

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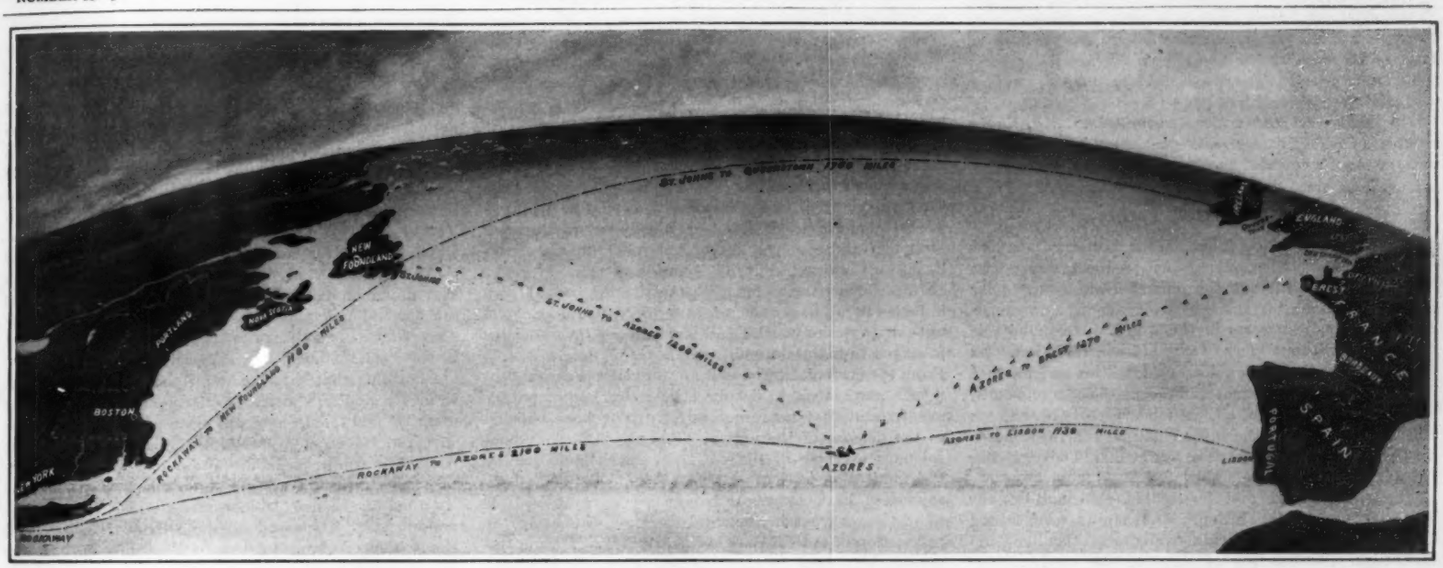

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Routes and distances which are available to British and American airmen who are to attempt the great trans-Atlantic flight

Our Navy's Bid for the Great Trans-Atlantic Flight

AGAIN the coming trans-Atlantic flight has taken an unexpected turn. A week ago all eyes were turned toward Newfoundland, where Hawker with his Sopwith and Raynham with his Martynside were momentarily expected to start on what is considered a desperate venture. Both those small biplanes were hastily prepared for the trans-Atlantic attempt and shipped to Newfoundland for an early start. But what with high velocity winds, storm areas in mid-Atlantic, fog banks, rain, marshy flying fields, and other elements of delay, the present writing finds the intrepid British pilots still waiting for favorable conditions to take off, as the aviators say. Perhaps the ill-fated start of Major Wood in his Short biplane, which resulted in his machine falling in the water while flying between England and Ireland, may have had a deterrent effect on the British aspirants in Newfoundland; at any rate, they are not taking the sheer desperate chances which everyone expected of their attempts.

Meanwhile our Navy's carefully laid plans and thorough preparations have been brought to what appears to be a successful and promising consummation. Indeed, during the past few days the NC flying boats have proved quite fit for the great ordeal before them. And these tests have even encouraged a remarkable record made by a Navy F-5 type machine, at Hampton Roads on Saturday, April 26th, which flew for more than 20 hours and covered a distance of 1,250 miles. The F-5 type is equipped with three Liberty engines, while the larger NC type carries four.

And while the aircraft have been carefully tested and prepared for the long flight, our Navy has gone ahead with other flight arrangements, such as a string of torpedo-boat destroyers and battleships which will be strung along the course across the vast expanse of ocean, so that the fliers at all times will be in wireless communication with naval units. There are several possible routes. The two which have been favorably considered are from Newfoundland straight across to the Irish coast, or from Newfoundland to the Azores and thence to some point on the Continent. Of the two routes, it appears that the one via the Azores is the more likely.

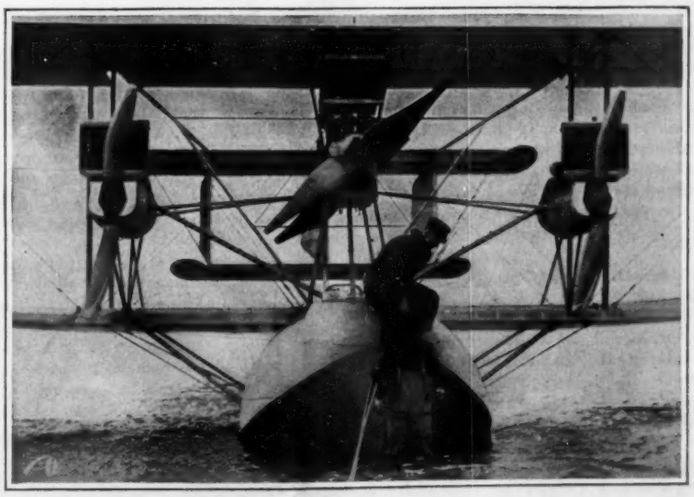
While little is divulged by Commander John H. Towers who is in charge of the Navy's attempt at trans-Atlantic flight, and his men, with regard to the destroyers and battleships which will no doubt span the ocean for the benefit and guidance of the airmen, it is quite evident that the Navy is taking no chances whatsoever. In fact, the attempted flight is not unlike a long-distance swimmer, who, while he must cover the distance on his own resources, is escorted by one or more boats which are ready to pick him up if necessary. In sharp contradistinction to the attempts of Hawker and Raynham with their single-engined biplanes and no escort or guiding vessels, in which event they must either succeed or trust to being saved while adrift in mid-ocean, our Navy's attempt is devoid of desperate hazards. It is not a sporting event; it is rather a well planned test conducted along sound engineering lines.

More is known about the NC planes, which are to attempt the flight, than about the navigating plans. The NC-1, which was the first of its type to be constructed made a spectacular flight on November 8th last, carrying 51 passengers at a time. As originally designed the NC-1 has an upper wing span of 126 feet, lower wing span of 96 feet, an overall length of 70 feet, and a total height of 25 feet. It weighs 13,000 pounds empty, and 22,000 pounds fully loaded. The useful load carried is 4½ tons. Although a big machine, the NC-1 has a speed of over 80 miles an hour, a 2,000-foot climb in 10 minutes, and a maximum endurance range of 13 hours.

Three Liberty engines were originally mounted on the NC-1. Each of these, being of the low-compression type, develops 350 horse-power. Four-bladed tractor air screws are used, each measuring 10 feet 10 inches in diameter.

The NC-3 and NC-4 which have since been completed, follow the same general lines as the NC-1, except that they are equipped with four Liberty engines, and the airscrew arrangement at present consists of three tractors and one pusher. These flying boats have a useful carrying capacity of 12,400 pounds, as compared with about 9,000 pounds for the NC-1, so that the four-engine equipment may be considered far more advantageous than the three-engine equipment despite the weight and fuel consumption of the extra engine, which would require some 4,025 pounds of fuel and oil for a 24-hour flight. It is understood that the NC-3 and NC-4 develop a speed of 95 miles an hour, and have a landing speed of 55 miles an hour. The gross load capacity is 29,500 pounds, although it is intended to start the ocean flight with not more than 28,000. The other measurements of these boats are

(Continued on page 495)



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Engines of the NC-3, showing the two regular tractor air screws and the tractor and pusher air screws of special design in the center

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

A Neglected Port

THE port of New York, so far as nature has had to do with the making of it, is the greatest port in the world; but the port of New York, so far as man has done his share as a partner with nature, is one of the poorest ports in the world. We make this statement without any fear of contradiction. As regards its loading and unloading facilities and all that ordered adjustment of material means to economic ends, which is the earmark of a great modern port, New York with the exception of the Bush Terminal and the Chelsea docks is, today, in a parlous state—like Topsy, it has "just growed."

The clear-headed and far-sighted chairman of our Shipping Board, Mr. Hurley, more than once has stated that an important factor in overcoming the handicap of cheaper construction of ships in the yards of our competitors, will be the speeding up of the turn-around of the ships of our new merchant marine in our own ports. This is to result from highly developed loading and unloading machinery and the carefully planned layout of our dock facilities. Of course, Mr. Hurley, at least so far as the port of New York is concerned, was looking to the future—certainly, he did not have in mind the existing conditions. At the present writing, we are at the state of development where committees, investigations, reports, and much perfervid oratory prevail. But surely it is about time that we got really and honestly busy in this the most important question affecting the commercial metropolis of the western hemisphere. It is a vast problem, which can be satisfactorily solved only by the coöperation of wide experience with the highest technical ability. If we are to find a quick and adequate solution, the whole thing must be absolutely divorced from state and municipal politics.

A fundamental question that must be decided at the outset is that of location. Are the present centers of shipping activity the most favorable, or should we develop new shipping centers such as that proposed at Staten Island or in the Jersey meadows?

Another starting point in bringing our port facilities up to date is to gather complete information as to the terminal facilities of the leading ports of the world. Presumably much of this information has already been gathered; but there has been considerable activity during the war, and the record should be brought up to date.

A Year of the Carnegie Institution

REVIEWING the exploits of the Carnegie Institution of Washington is a habit which we should be sorry to abandon. There is hardly any other documentary material in the modern world that inspires us with just the same sort of emotion that we derive from the Yearbooks of that admirable establishment. If we had lived at Alexandria in the days of the Ptolemies we might have enjoyed similar thrills in perusing the periodical reports of the Museum, supposing that any were issued. The Ptolemiac investigators had the advantage of virgin fields for their adventures and they must have had amazing stories to tell. Research under the Carnegie Institution starts at a different stage, but it plunges so boldly into the illimitable unknown that it is positively invested with the true flavor of picneering.

Possibly some of our readers have never seen a Yearbook of the Carnegie Institution. Let them imagine a volume of more than 300 pages, delectable in type and paper, setting forth some of the most romantic true stories to be found in contemporary literature. Not that the writers of these stories deliberately court popularity. Their language is formal and technical. It is facts, not phrases, that exercise the spell.

One of the many departments of the Institution possesses the most powerful telescope in the world, installed on the top of a mountain in California. Here is a circumstance to arrest public attention; yet it is almost trivial compared with the sum total of facts concerning the equipment, personnel and program of the Mount Wilson Observatory—easily the most progressive astronomical establishment in the world. Another Carnegie department has furnished a pair of seven-league boots to the once languishing science of terrestrial magnetism. Biology is represented by several branches of the Institution, in each of which new vistas are continually being opened up. And so on, pretty much through the circle of the sciences.

No educated person can afford to be ignorant of what the Carnegie Institution is doing. It would be a praiseworthy undertaking if Director Woodward would issue a popular and copiously illustrated version of the Yearbook, for the benefit of the busy average man.

In reviewing the report of the Institution for 1917, we indulged in a quizzical commentary on the subject of the unruffled exterior which Dr. Woodward and his associates managed to maintain amid the alarms of the great war. From the current Yearbook it appears that the establishment, was, in fact, deeply stirred by contemporary events, and that its resources have long been enlisted in the defense of the nation. Probably the most conspicuous example of the patriotic service rendered by the Institution is the fact that the entire staff and resources of its Geophysical Laboratory were utilized for more than a year in the vital work of promoting the production of optical glass in this country. During this period the output of uncut optical glass was increased from less than a ton a month to more than 100 tons a month, and it was thus possible to supply the Army and Navy with telescopes, field glasses, gun-sights and various other optical apparatus, despite the cessation of the supply from abroad. Several other branches of the institution also coöperated actively in war work or were well represented therein through the activities of their officers and employees.

At the beginning of 1918 the Institution entered a new field of investigation through the acquisition of the Eugenics Record Office, located at Cold Spring Harbor, Long Island. This unique enterprise was previously maintained mainly at the expense of Mrs. E. H. Harriman, who has provided a fund of $300,000 toward its further maintenance.

Many of the more noteworthy achievements of the Carnegie Institution during the past year are recorded elsewhere in our columns.

The Battleship of the Future

WHAT is the best type of capital ship to build for the United States Navy? Is it expedient to go ahead and build the two types which have been designed for our Navy, namely, the 42,000-ton, 12-gun, heavily armored 23-knot battleship and the 35-knot, eight-gun, lightly armored battle-cruisers that have been designed and appropriated for? Or would it be wiser to combine the two designs in a composite ship, having something of the gun power and protection of the battleship, and approximately the speed of the battle-cruiser? The officers of the staff and the line of our Navy—that is, the men who design and the men who fight the ships, are giving this question close attention, and already there is a division of opinion. Experts such as Admiral Mayo, Vice-Admiral Sims, and Rear-Admiral Rodman, the three who have held the highest commands of the American service in the war zone, believe that the composite type is better; the men who were engaged at home, including Rear-Admiral Fletcher and the General Board who advise on the material of the Navy, believe in holding to the existing types. Meanwhile, the chiefs of the bureaus of Construction, Steam Engineering and Ordnance are in Europe, making a study of this question based on the results of the war and on the material that was built for its prosecution.

Those of our readers who interest themselves in naval affairs, know that the modern warship is a compromise. In its completed condition it has a certain displacement, or weight, and this is apportioned to the various elements that go to make up a fighting ship, all of which make their demands upon the total weight available. So much weight must go for hull, so much for engines and boilers, so much for armor, guns, fuel, and general equipment and stores. If one of these elements be greatly favored, it will be at the expense of the others; and he is the wise designer who can make a perfect distribution for the particular class of work in which the ship under design is to be employed.

For these reasons, it follows that the battleship with a maximum protection has only a moderate speed of 20 to 23 knots, and the battle-cruiser, in which speed is the chief desideratum, carries, relatively to the battleship, a lighter armament and much lighter protection.

Now the British, as a result of their war experience, and particularly in view of the lessons of the Jutland fight, have come to the conclusion that in a compromise ship of large displacement, embodying the best elements of the battleship and the battle-cruiser, is to be found the ideal capital ship for the tactics of future battles, so far as they can be predicated on the experiences of the war. They laid down three great ships of the "Hood" class, which were under construction when the armistice was signed. In agreement with their desire and expectation that disarmament and demobilization on a considerable scale would be possible, now that the arch enemy was gone, they at once broke up two ships of the three; but because the "Hood" was very largely completed, they are finishing that ship. The "Hood" is about 900 feet in length and will displace, on English normal loading about 41,000 tons, which will mean probably 43,500 tons with full stores, etc., aboard. She is to have moderate battleship armor, probably of about 12 inches; her battery will consist of eight 15-inch guns, or, possibly, of six guns of the new 18-inch piece, which fires a 3,600-pound shell. The speed will be 30 knots, which is about the best speed of any existing battle-cruiser in the navies of the world.

After a careful study of the subject, the SCIENTIFIC AMERICAN is inclined to the belief that the compromise ship is the better type. The sinking of three British battle-cruisers by the 11- and 12-inch guns of the Germans proved that battle-cruiser armor, as carried by the British and Japanese, which are the only navies which possess battle-cruisers, is insufficient to insure the safety of such ships. In fact, 6- to 8-inch armor is absurdly inadequate; whereas 12 inches of armor, associated with sufficient deck protection, will give a ship reasonable immunity. This was proved in the case of the German battle-cruisers at Jutland, which, by the way, except for the rather light guns they carried, were practically of the new composite type. Increase the displacement of the "Doefflinger" to 32,000 tons, raise her speed to 30 knots, substitute 15- or 16-inch guns for her 12-inch, and you have an excellent ship of this new type.

The battle-cruiser must go; it has filled its place in the history of the development of fighting ships and filled it well; but in an age when the principal batteries of the capital ships include our own 16-inch firing a 2,100-pound shell, and may possibly include the British 18-inch firing a 3,600-pound shell, the building of capital ships whose engine weights are so great that it is impossible to give the ship more than six inches of armor protection, is to invite disaster. If the speed of our battle-cruisers were cut down to 30 knots, and the large amount of weight saved in the reduction of boiler and engine plant were translated into heavy deck armor, we would have an ideal ship of the new type.

The policy of the United States Navy, when war is on, will always be aggressive. We shall attack; and one of the best defenses, both against gunfire and the torpedo, is high speed and a quick helm, or maneuvering power. Even the battleships of Jellicoe's fleet, which maintained a speed of 17 knots only during the battle, were very successful in eluding the torpedo, no less than 20, which passed through the line, being avoided by the use of the helm. These, however, were partially-spent torpedoes. Had the German destroyer flotillas been less cautious and closed into closer range before firing, the result might have been different. But a 30-knot ship with good lookout, and quartermasters who are on the job, would be reasonably immune to a destroyer attack launched at five or six thousand yards.

Electricity

An Easy Method of Mastering Wireless Operating.—One of the leading phonograph companies has recently introduced a complete set of instructional records and books for those who wish to master wireless telegraphy at home. The records, together with the books, serve to train the ear to the dots and dashes of the telegraph code.

Our Increasing Telephone Service.—The number of telephones in use in the United States at the close of the year 1917 was 11,713,228—one to every nine persons; and an average of more than 200 calls for every man, woman, and child in the country were made during the year. The total number of employees of commercial telephone systems was 262,622. For the 10-year period 1907-1917 the salary and wage payments increased 157.3 per cent, the expenses and fixed charges 126.6 per cent, and the total income 112.2 per cent. The Bell telephone system, together with the independent lines which are connected with it for the interchange of local and long distance service, comprised 89.6 per cent of the total number of telephone installations. These facts are culled from the preliminary report of the telephone industry recently prepared by the Bureau of the Census.

Principles of Radio Communication.—The Signal Corps of the United States Army is to be commended on a very excellent work which it has recently published under the title of "The Principles Underlying Radio Communication," or designated as Radio Pamphlet No. 40. This book contains over 350 pages, and is replete with interesting and instructive diagrams and photographs. As its title implies, it deals with the simple principles upon which radio communication is based. Starting off with the simple principles of galvanic and static electricity, the reader is soon led on to the elementary principles of wireless transmission and reception, and gradually to the intricacies of modern vacuum-tube apparatus and so on. This book may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.

A Huge Telephone Switchboard.—The telephone quarters in the new Pennsylvania Hotel, New York city, occupy 3,165 square feet of floor space, having an operating room 110 feet long by 15 feet wide, a terminal room 30 feet long and 25 feet wide, a rest room 23 feet by 15 feet, and a locker and washroom 30 feet by 14 feet. The operating force consists of one chief operator, one assistant chief operator, eight supervisors, and 110 attendants. The switchboard consists of 23 positions. Thirteen positions are equipped with telautographs used for paging and announcing only. The switchboard has a capacity of 3,340 extensions and 260 trunks, and is equipped for 2,500 extensions and 180 trunks. The hotel has telephone service in each of its 2,200 rooms, and there are 40 public telephone booths served by four switchboards connected with the main switchboard. The following gives some idea of a few of the items which make up part of the telephone system: 630 fuses, 1,170 condensers, 2,400 relays, 5,350 lamps, 38,500 jacks, 750,000 soldered connections, 7,926,000 feet of wire.

Advantages of the Electric Range.—Speaking about its automatic electric range, an electrical manufacturing company has the following to say. The use of the range in the long run is not an expense but a saving. It helps cooking to become such an exact science that no food is spoiled. Results once obtained can be exactly duplicated. Meats actually shrink less in an electric oven than when cooked in the ordinary gas or coal range. Cooking by this method is absolutely sanitary as every part of the electric ovens can be thoroughly cleaned. Ranges can be obtained in sizes suitable for large families and small enough so that they are economical when cooking for two. The ovens are made to hold the heat. This saves electricity as most of the cooking is done with stored heat, and it keeps the heat in the stove instead of scattering it in the kitchen or over the house. This is a wonderful relief in baking or in any cooking in the summer time. The oven will cook a whole meal. Vegetables may be put in with the meat at the same time. Breakfast can be put in the oven the night before, the clock set and a few extra winks are possible in the morning; for the automatic range gets on the job at the desired time. All parts of the ranges are of metal, substantial and fireproof and approved by the Fire Underwriters. All of the electric heaters can be regulated for three distinct heats—high, medium and low.

Science

Seaweed as Cattle Food.—Investigations of seaweed with reference to the possibility of using certain species as food for cattle have recently been carried on at the Royal Agricultural Station for the Control of Cattle Food at Wageningen, Holland. The general conclusion reached is that, in the absence of other roughages, seaweeds may be fed to cattle, when the sodium chloride has been sufficiently removed. In Ireland, Scotland and the Faroe Islands dried seaweed is used as a winter feed for cattle and horses. In southern Sweden it is fed to swine. In Germany, during the war, special instructions were issued concerning the gathering and preparation of seaweed for use as fodder. The weed was to be spread out so that the rain could wash out the sodium chloride; then dried and baled in a press.

A Soil Temperature Survey of the United States and Canada.—A committee of the Ecological Society of America, consisting of Dr. Forrest Shreve and Dr. A. E. Cameron, has organized the important work of making a soil-temperature survey of the United States and Canada. Hitherto measurements of soil-temperature have been made only in a desultory way in this country and the data are not homogeneous. The present plan is to carry on observations at various places for a number of years under identical conditions. Upwards of 30 stations are now in operation. Thermograph records are obtained for thermometer-bulbs placed at the same depth (three inches below the ground at all stations with additional readings at 12 inches at certain stations), in level, well-drained soil, free from the shade of trees or buildings, and under a ground-surface kept free from sod or weeds, but without continuous cultivation. It is hoped that the data obtained will make it possible eventually to draw isotherms for the soil of the United States and Canada analogous to those that have been drawn for the air over the same countries.

The Bactericidal Action of Sunlight.—Results of experiments made at Algiers by M. de Laroquette, published in the Annales de l'Institute Pasteur, indicate the necessity of revising current ideas concerning the bactericidal action of sunlight. These experiments show that sunlight is bactericidal only with prolonged or direct insolation, and its action is chiefly effective on the surface of dry media and in air, where bacteria are fully exposed to the sun's rays and to desiccation. In liquid media the bacteria are only destroyed when the light is very intense, and then only at shallow depths. Total white light is much more efficient than any partially colored light. Blue light is slightly more bactericidal than other colored lights. Contrary to a prevailing opinion, ultra-violet light plays but a slight part in the bactericidal action of sunlight, and the same is true of infra-red. The luminous part of the spectrum is the most active in killing bacteria. These experiments indicate that in hygiene and therapeutics it would be useless to rely largely on the bactericidal action of sunlight, especially in temperate regions, as it has no effect at a depth exceeding a few millimeters and is inhibited by thin layers of fat or muscle.

Studying the Color of Fishes.—For some years past Prof. W. H. Longley, of Goucher College, has been studying the colors and patterns of fishes in relation to their habits, and has shown that these colors and color patterns help to render the fishes inconspicuous, thus serving to protect them from their enemies. Last summer Professor Longley visited Hawaii, equipped with a diving-hood, submarine cameras and apparatus for color photography, and continued his investigations in a coral reef region, on Molokai Island. His work often required him to remain four or five hours at a time under water of considerable depth. Professor Longley has been successful in securing accurate submarine color photographs, but only after much experimenting. He finds that the screens used for color photography in the air are not suitable for use under water. It is necessary, he says, that a special screen stopping more of the rays of shorter wave-length than is required in air should be used in submarine color photography, and even then the best results at a given depth and time could probably be obtained by its use at only one distance from the object photographed. Hawaiian fishes show a marked capacity for changing their coloration with change in surroundings or activities. Professor Longley found 27 species, representing 22 genera and nine families, that possessed this faculty.

Aeronautical

Chicago-New York Non-Stop Flight.—Capt. E. F. White, an Army aviator, recently flew from Chicago to New York without stop, thus establishing an American record. He left Ashburn Field, Chicago, at 9.50 A. M. and landed at Hazelhurst Field, Mineola, at 4.40 P. M. covering the distance of 727 miles in six hours and fifty minutes. His average speed was 106.38 miles an hour, and most of the flight was made at an altitude of 12,000 feet.

American Naval Airmen.—According to French records, the United States Naval fliers damaged and possibly destroyed 12 German submarines. Captain Thomas C. Craven, U. S. N., commander of all the United States naval aviation forces in France, who recently returned from abroad, takes a more conservative view and concedes the sinking of two and the damaging of eight U-boats. The growth of the United States naval forces in France was rapid. Indeed, from nine small seaplanes, our naval wing soon expanded to more than two hundred seaplanes of the best types, operating from a port near Brest. It is recognized that these forces had a material effect in curtailing enemy submarine successes near the French coast.

Civilian Flying in Great Britain.—On May 1st the ban on civil aviators was raised in Great Britain. The Air Ministry in preparation for the advent of commercial flying, mapped out various routes along which the civilian aviators can find airdromes and mechanics for their machines. These thoroughfares will not only enable direct communication between London and Ireland, and London and the north, but also will cater to some of the more important towns in the industrial districts. Airdromes for traffic to and from overseas are for the present limited to four. At these, overseas machines must land for examination of goods and passengers. The airdromes are, for continental traffic, at Lympne, in Kent; for Dutch traffic, at Hadleigh, in Suffolk; for Scandinavian traffic, at New Holland, in Lincolnshire, and for traffic direct to London, at Hounslow, in Middlesex.

British-built Passenger Air Liner.—The *Daily Telegraph* of recent date gives a description of the new passenger air liner recently constructed at Filton, England, by a Bristol company. This airplane has a seating capacity for 14 passengers in addition to the necessary staff; on its trial trip it carried 12 passengers, pilot and assistant, and attained an altitude of 6,200 feet in 7¼ minutes with an air speed of 125 miles an hour. The passenger saloon is scientifically ventilated to avoid drafts, and straps are not needed for passengers, as on this class of machine rolling and pitching are scarcely noticeable. The machine measures 20¼ feet high and from tip to tip measures 81½ feet. It weighs 16,500 pounds, the power being sufficient to lift this load to a height of at least three miles and at 10,000 feet to give the airplane a speed of 113 miles an hour. The engine houses are built on the middle of the three pairs of wings; on each side there are two 410-horse-power engines, the total power being 1,640 horse-power. Flight can be maintained by any two of the four engines should the others break down.

Proposed Air-Traffic Regulation.—A copy of the report of the Interministrial Commission of Civil Aeronauties which the French Ministry of War has received from the Ministry of Foreign Affairs, has been received from Counselor Robert Woods Bliss of the American Embassy at Paris. The report comprises a "Project of international convention regarding air navigation," and proposes to forbid the carrying of cameras, war appliances, or ammunition on airships, without special authorization, and to allow the contracting governments to forbid private individuals of any nationality to fly over certain specified zones of their territory. Provision is made for the classification and registering of all airships, whether planes, balloons, or dirigibles, the lists to be exchanged between the contracting governments. It is also proposed to standardize the conditions under which navigation licenses will be granted to machines and to pilots. Various annexes to the report offer provisions for the standardization of lights on airships, and for route and driving regulations, and suggest a number of distress signals which it is proposed to offer as a basis for an international standard code.

The Tank Man's Story

As Told to C. H. Claudy, Special Correspondent of the SCIENTIFIC AMERICAN in France

"YES, you read a lot in newspapers about tanks. But no American tanks saw any action in France. There were three battalions of American tank troops that saw action; one with heavy tanks, with the British, and two, with light tanks, operating in the Argonne and the St. Mihiel actions. Some troops, too if I do say it who shouldn't! No, you'll have to get some one else to talk about the heavy tanks; don't know anything about them and don't want to. Light tanks for me, every time. Yes, I'll tell you about them if you are interested.

"We used Renault tanks—light ones. Whippet tanks some people call them. Weigh about seven tons and have two men for a crew. Fast? Too fast; faster than there's any use for them to be, really. That was one of our troubles, running away from our infantry. No sense in having tanks that can get out of touch with the men they are supposed to precede and blaze a trail for! Those little Renaults can go eight miles an hour over good ground, and infantry is lucky if it goes two!

"What? Oh, one of them is the engineer and the other the pilot. Some of the tanks have machine guns and some one-pounders; only one gun to a tank you know—those little fellows aren't battleships. We started in with 216 tanks. They cost about $10,000 each. Yes, motor not unlike a good automobile motor; four-cylinder, about 40 horse-power. Indeed the tank has a lot of automobile mechanism about it. Those Renaults have four speeds forward and reverse. Clutches? Three to a tank. One main clutch and then a tread clutch, so either tread can be used separately. That's the way the tank is steered, you know. Two levers. If you want to go to the right, pull the right hand lever. That disconnects the right hand tread and lets it run free. The left hand one, still engaged, pulls the left side of the tank around faster and you turn to the right. Pull the lever still further and the right hand tread is locked. Then you spin around in your own length. It's astonishing how fast those little tanks can turn when they have to. Fast enough to cut a man in two if he's in the way. Yes, it happened more than once. Some Boches had an idea they could do something to a Renault with a hand grenade and tried it at close quarters. Might just as well have thrown eggs at us, unless some splinters got in the slits. And if they were close enough and we whirled her round they were out of luck sure—broken legs, you know, or mashed ribs.

"No, the Boche anti-tank gun never hurt us to amount to anything. Ever see one? It weighs about 50 pounds and shoots a whale of a bullet, but unless it strikes sharp at right angles it doesn't get through. Pretty hard steel, you know, that tank armor. What did stop us, when we were stopped, was the 77. Even that took a direct hit. A 77 could go off right beside us and we'd hardly know it. But if it made a direct hit—well, you don't expect to run a war without any casualties, of course. I recall one case where a 77 made a hit and set off all the ammunition in the tank. The tank was scrap steel and the men—well, we found a hand, and a shoe. Just literally blown to nothing.

"Terrain? Of course there are places a tank can't go. You read a lot about how a tank loves mud. Don't you believe it. A tank can slither around in mud just like an automobile. Of course it can go, but it can't climb at the same angle on mud as on dry ground and somehow we always did fight in the mud. France is a great place for mud; if you could sell it France wouldn't have any national debt at all. Mud didn't stop us of course, but it made it more difficult. On dry ground we can climb 45 degrees, and 51 degrees in reverse.

"You hear a lot about the way a tank can crawl over trenches. But that's the big heavy tank. The little fellow can't run over a trench the way it can down and up a shell crater. The Renault is tail heavy, you see. It gets its nose across a trench all right, but if the trench

Head protection worn by tank gunners when looking through the sighting slits

is a little too wide the heavy tail drops back into it. Then you have to get out and dig or get another tank to come and pull you out. That's why two tanks together are worth four separately. They can jam themselves up and still get along by doing the brother act with chains. Once that I know of a tank got stuck and the second tank couldn't pull it out. So the officer outside signals another tank and it comes up—all this under fire, mind—and he hooks that on, too, and the two of them pull the helpless one up and over. He got the D. S. C. for it, that officer.

"It's not nice when you're stalled, you know. As long as you can move around, the 77 has a hard time getting you. But if you get stuck somewhere it doesn't take a Boche gunner so very long to get your range. That's why we were so anxious to have self-starters put on the American tanks, when we thought we were going to have American tanks. If there had been any self-starters on our Renaults, we'd probably be shy about twenty casualties. Engine stalls, Boche gets busy, chap inside struggles with a crank, takes time, 77 lands, signal back for a reserve tank to come on into action. No, they didn't put the self-starters on. Don't ask me why; I don't know.

"Sure, the American tanks were good tanks. We never used them in action that I know of. Those I saw got to France, or got where they might have been used, after the Armistice. But they were sure American all over—too much American, if you know what I mean. It's a national failing, I guess, this business of being ingenious. There was so much ingenuity about those tanks there wasn't always room for the crew. For instance, machine gun belts. When you use them, they are rolled up and in a carrier. Some wise tank builder decided all the ammunition in a machine gun tank ought to be in carriers, rolled up ready for use. When he got through, there wasn't any room inside for the crew! No sense to it, of course; the same amount of ammunition stores flat, and leaves plenty of room, and it only takes a few seconds to roll up a belt and put it in a carrier.

"Then there was the compass. Some one must have read that British tanks carried compasses. So they did, until the tank crew could throw it away. So our American tanks came over with the handsomest compasses inside you ever saw; regular ship affairs, gimbels and all! Now, of course, that's all foolishness. In the first place there wasn't room for the compass and the crew. In the second place, when you start the engine, the compass does a fox trot, and keeps on whirling; it's no good as a compass. And if it was, there wouldn't be any sense in it; there's a map stuck up right under your nose and that's all you need, not to mention a few officers with flags telling you where to go, if they are not sitting on top going with you.

"Then there was the speedometer. Why any one should imagine a tank crew needed a speedometer I don't know. But there it was, ready to tell us just how fast we were going. Maybe they thought, down in Washington, we were going to establish a tank speed record or something.

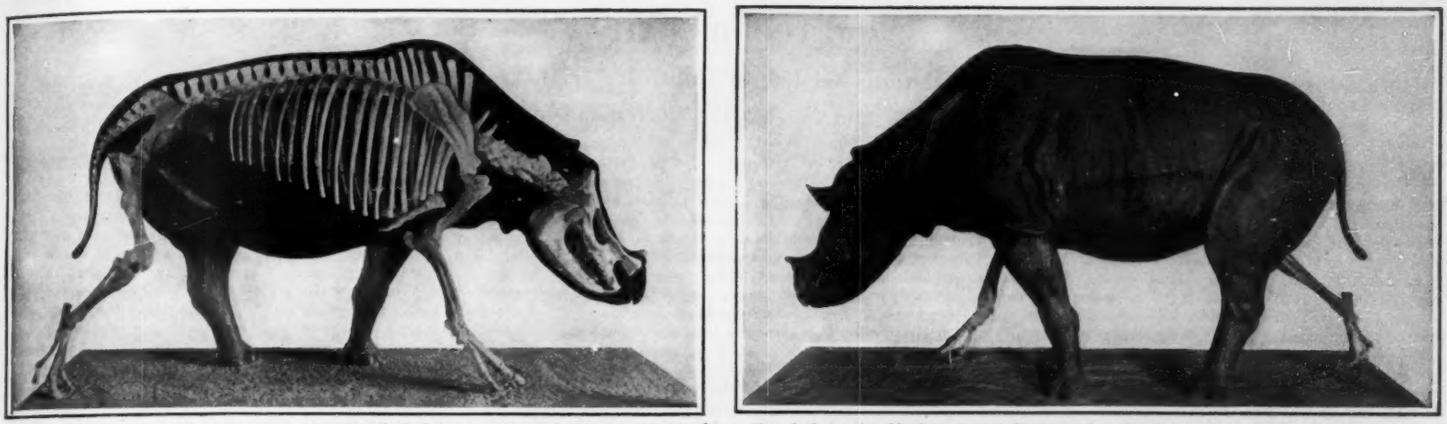
"And the hook—I mustn't forget the hook. It's so typically American. To put a hook in at the top of the tank meant at least two hours' time. In 100 tanks that was 200 hours or 24 working days, slowing up production. The idea of the hook was that it would be so convenient when a crane had to lift the tank. Now the average tank gets lifted by a crane just four or six times; on a car at the factory, off the car, on the ship, off the ship, and maybe on and off a car again. So to save the six or twelve minutes it would take a crew to slip a chain around the tank, they put a hook at the top, because it was efficient!

"Oh, well, I oughtn't to grouch. We never used the tanks. And no one that I know minds much. Those Renault tanks were little dandies. You have no idea

(Continued on page 496)

French tanks moving to the support of French troops

French Renault tank with an American crew



The new technique for mounting fossil skeletons. One side of the exhibit shows the skeleton itself, the other indicates what the living animal looked like

Fossil Deposits of Nebraska

What Geology Tells Us of the Prehistoric Fauna of the Plains

THAT the largest fossil deposits in the world are found in the Agate Spring Quarries of northwestern Nebraska is a fact known to probably very few people outside of those directly concerned in the fossil business or, more properly speaking, those technically interested in natural history. To Capt. James H. Cook and his son, Harold J. Cook, of Agate, Neb., we are indebted for the discovery and subsequent development of these quarries through which a very considerable portion of the knowledge of the fauna of this hemisphere in prehistoric times has been derived.

Captain Cook went to Nebraska in the early seventies with a party of hunters; the country then was a hunter's paradise; the bison, roaming unrestricted over the prairies, and other large game were in abundance. Realizing the possibilities of the land for agricultural and cattle-raising purposes, he staked out a claim and settled where now is the well-known Agate Spring Ranch. Captain Cook was not merely a hunter; he was a scholar and zealous student of science. The fossil bones that he discovered on his land he realized were of great value to students of paleontology.

The National Museum of Washington was notified of these discoveries, but did not respond to his invitation to come and investigate. The University of Nebraska first took up the work; under the direction of the state geologist, E. H. Barbour, the whole section was thoroughly explored and many fossil bones removed. Later Captain Cook's son, Harold J. Cook, went to Columbia University and took a post-graduate course in paleontology. While in New York he succeeded in interesting the American Museum of Natural History in these rich fossil deposits and, in response to his invitation, they went to Nebraska to explore.

Since the time of their first visit they have been actively engaged in prospecting and removing specimens. At one time, by placing a blast at a depth of 50 feet, they blew off the top of a conical shaped hill and exposed a layer of fossil bones 12 to 30 inches in thickness and one-eighth of a mile in diameter. The whole region in the vicinity of this quarry is seemingly inexhaustible in the richness of its fossil deposits. There are various suppositional causes for this prolific supply, the most plausible, in the opinion of Mr. Cook, being that some widely spread epidemic caused the animals to rush to the waters of the Niobrara and there in vast numbers they died and were buried in the sand washed down by floods. That they were all covered at the same time is evident from the layer of sand in which they are found.

The specimens obtained from this area represent a large variety of animals of the lower Miocene and upper Oligocene periods. Here has been found a complete skeleton of the giant Dinohyus, or giant pig, of the lower Miocene. This animal was most formidable in appearance, being six or more feet in height and with canines that formed stout and heavy tusks. The head was very long and was made very grotesque in appearance by large bony growths on the skull and jaws. For a pig, the legs were very long and gave the animal a stilted look.

Another complete skeleton found is that of Moropus, the clawed horse, already described in these columns, than which a more grotesque creature could hardly be imagined. This animal lived in the lower Miocene. It was larger in bulk and stature than a large horse, had a long neck, and rather small, horse-like head. The fore limbs were long and the hind legs much shorter, giving the animal a steep inclination from the shoulders to the rump. The feet were armed with great claws. Almost nothing is known of the habits of this queer beast but judging from the character of the teeth, neck, and fore legs it is reasonable to infer that it fed on the leaves of trees.

By far the most numerous of all the fossils found in the Agate Spring Quarries are those of the Diceratherium, or paired-horned rhinoceros of the lower Miocene and upper Oligocene epochs. They were different from all other rhinoceroses in having a transverse pair of horns on the nose; in all subsequent two-horned species the horns were one behind the other. These animals were very small, not more than half the size of the present-day African variety. The accompanying cuts show the complete skeleton of one of these small animals and also the animal as restored from the skeleton by J. D. Figgins, Director of the Colorado Museum of Natural History, at Denver, Colo.

This method of exhibition, originated by Mr. Figgins, marks an innovation in fossil display. The two cuts show the two sides of the same exhibit; one side shows the animal as it appeared in life, and the other shows the assembled skeleton occupying its exact relative position in the hollow interior of a longitudinal half of the restored animal. This new method of skeleton mounting is now on exhibition in the Colorado Museum. There also may be seen a slab of rock four and a half by six feet in size, taken from these same quarries just as it occurred in the formations, and showing the fossil bones in high relief.

Although promiscuous prospecting for fossils on the land owned by Captain Cook and his son is not allowed, they not only permit people of recognized authority in the realm of paleontology to take away all the material wanted, but such people are most cordially invited by them, and treated with the utmost courtesy while there and given every possible assistance in the work of removing specimens. Although most of this work has been done by the American Museum of Natural History of New York city, many others have been actively interested and have taken away valuable material, notably the Carnegie Museum under the direction of O. A. Peterson, and the University of Nebraska under Barbour as already mentioned.

Nebraska fossils in situ, the rock having been chiseled away to show the bones in high relief

German Glass "Film" for Motion Pictures

IT is reported that a new method for producing motion pictures by projection through a glass film (as distinguished from the usual commercial film of celluloid), has been worked out by the management of the famous optical glass works located at Jena, Germany.

This new glass "film" has the advantage of being only one one-hundredth as large as the film now in use.

This so-called glass "film" is in reality a very thin plate of glass, upon which the necessary number of prints are made, and which is shifted mechanically before the arc. It is not known whether this method of projection is in commercial use.

Free as Air

Legislation Needed to Control Aerial Traffic

By Our Washington Correspondent

WE are in danger of losing our symbol of absolute freedom. Air is very shortly to be anything but free, and necessarily so, if the war-time development of aviation is to be followed by a corresponding progress in these days of peace, and the new art is to become a real integer in economic progress.

Legislation must control aerial traffic. Any large number of air craft can no more be permitted to fly where they will than a fleet of automobiles be permitted to run at what speeds their owners please.

No such restrictions regarding air craft should be permitted in this day and age. To prevent foolish restrictions legislation controling the nation's air-ways should be undertaken by the Federal government, that we may not have 48 sets of laws regarding air travel, according to 48 standards of ignorance and foolishness.

If it seems that no legislation beyond that affecting landing be required, let us consider aviation in its international aspects. Is a machine foreign when manufactured abroad but driven by an American pilot? Is an American machine American if driven by a foreign pilot? How far up does a national boundary extend? Can one fly from the United States into Canada or vice versa at one's pleasure? If permitted to fly across the international boundary provided one does not land out of one's country, what regulations affect a forced landing? How insure recognition of machines? If I fly over your property and drop a wrench through the roof of your house decapitating the cat, what recourse have you, and how will you know which of the various planes flying overhead to accuse? How high do you want me to fly when I pass over your house? How high do you own the atmosphere over your land? If you claim ownership according to the old English doctrine of *usque ad coelum*, how do you determine I am violating your ownership when I am a mile up? What regulations do you want enforced regarding my fitness to be a pilot or the fitness of my machine to navigate the air?

In France are two airplane lines carrying passengers. Both are operated by one company. Suppose you and I and several others all establish passenger-carrying airplane lines from New York to Washington. Who has the right of way? At what heights do we fly to avoid collision? Who maintains the aerial lighthouses which must send part-colored beams skyward? If the Federal government establishes aerial signal stations, it is fair that those who benefit should pay for them, which means licenses for aviators and machines.

The Federal government inspects steam boats. No steam boat operates under the American flag but has a regular inspection of its boilers, engines and hull. It cannot be overloaded at the avaricious pleasure of its owner to the endangering of life or property. Obviously, similar control of goods and passenger-carrying aircraft must come into being.

How far it must extend is a matter for the future. Private ownership of non-commercial planes may be left untouched, on the theory that no aviator will joy-ride aloft in an insecure plane. But a few wrecks would result in demand for both license and inspection. The automobile, if it refuses to go, damages no one. The aircraft which stops in midflight may come down in any one's back yard and kill a few innocent uplookers. If caused by reckless taking up of craft not fit, some legal control must swiftly follow. This means inspection, a service, and money . . . and one comes back to licensed control as the means of paying the bills.

Where may an airplane land? If I land in Farmer Johnson's wheatfield he comes with a few hired men, carries my machine to the nearest grass field, asks me to supper and treats me as a distinguished visitor. I am a curiosity—an adventure—a reckless human doing something he has read of but never seen. But let me be followed by a few dozen other luckless aviators, all of whom select Farmer Johnson's wheatfield for a landing place and his hospitality speedily wears thin. What right have I to tear up his landscape? What right has he to object if I *have* to come down? My life is worth more than his wheat, yet his wheat represents labor and money, which I have no right to take, even in necessity, without compensation.

Shall airplanes land on public roads? The plane which can land without a long ground run is but around the corner of the future—Vedrines has landed on a roof and a hundred experimental stations are working on the alterable wing-angle to apply an aerial brake. Yet if planes land on the public road, what becomes of the speeding autmobile which comes around the curve with no idea of any mechanical bird disputing its right of way?

Some one answers "plenty of landing fields" and some one has a good head. At present the establishment of landing fields seems essential, if the plane is to take any great place in transportation. New York, Philadelphia and Washington all have areas on which airplanes may light. But unless the Federal government interests states, counties and municipalities, landing control will remain vested in the individual locality and infinite damage be done a new development of transportation by the greed of some who can see only the immediate present.

The passenger-carrying trade of the air probably lies in the dirigible rather than the plane. "Special delivery" of passengers in a great hurry will undoubtedly compete with the slower dirigible. But the dirigible offers many possibilities which the airplane doesn't know—larger cabins, cooked food, sleeping quarters for overnight journeys, stability, absence of vibration and unbearable noise as well as a gentle landing.

How shall such vessels be marked for night travel? What sort of lights shall they carry? At what heights must they pursue their course? Fill the air with planes as the streets are filled with cars and let dirigibles be as numerous in the atmospheric sea as liners in the Atlantic, and collisions aloft will become a vital matter. Some regulations must be enacted by some controlling force or aerial navigation will be at once dangerous and unpopular.

Reverting to the question of damage to people or property on earth; if airplanes carry numbers on the underside of the wing, machines must fly low enough for

(*Continued on page 497*)

Shale Oil as a Business Proposition

A Timely Word of Caution as to Processes, Costs and Profits

By H. L. Wood

IN 1913 the United States Geological Survey began investigations, surveys and analyses of oil shales in Colorado, Utah, Wyoming and Nevada. Two comprehensive bulletins have been issued, the latest one detailing the work of 1917. After this work had been carried to a definite stage, Secretary Lane suggested that certain areas of oil shales be withdrawn as naval reserve; and early in 1917 this was done. At the same time a general description was issued of the oil shales, their location, character, etc.

This sudden publicity of course led to much interest in oil shales—interest that was kept alive by further government publications and by statements from chemists and engineers. All through 1917 owners of patented land in the states mentioned were busy with the formation of companies and the negotiation of leases. Approximately 100 companies were organized in these states, and their stock put out as actively as the public would absorb it. Remarkable prophecies have been made, and generally accepted. It seems therefore in order to point out the exact basis of proved fact that lies behind these forecasts, and the exact degree to which realization seems probable.

The key to the whole situation is the statement that from the oil shale deposits of Colorado and Utah 36 billion barrels of crude oil can be distilled—more, by billions of barrels, than all the wells in the world can ever produce. If this is strictly and practically correct, its bearings are so obvious that they need hardly be pointed out. But as a matter of fact, the statement quoted is just about as futile as is the computation of the total amount of oxygen or nitrogen in the atmosphere, as a basis for commercial action.

It is understood, when we say that two trillion tons of coal have been definitely located under the soil of the United States, that this figure has of itself no particular relation to the amount of coal available for our use. The latter item depends upon location, with reference both to overlying strata and to markets; it depends upon costs of mining, and upon methods now known or to be developed. Large deposits of high grade coal which today cannot be mined profitably or cannot profitably be transported to market, may yield to a process of tomorrow or may be put upon the commercial map by a change in the distribution of consumption or in the conditions surrounding use.

So it is with the shale oil. If one could stand before Colorado's mighty cliffs, waving a magic wand or rubbing an Aladdin's lamp, and make their oil content instantaneously available at our manufacturing centers, in our homes and on our ships—then the figure 36 billion barrels would possess practical significance. Then it would be in order to look for vast and immediate profits from shale oil, and to regard this source as about to effect a revolution in our fuel supply. But with things as they are, we must face a great many adverse factors before we can make any just estimate of the position to be occupied by shale oil, either in the immediate or in the remote future.

The first of these factors is that of oil content. Of more than 200 samples of shale secured in three states, the range was from one gallon to 90 gallons per ton. The majority of the samples ran from 15 to 35 gallons; the average was at most no more than 42 gallons, or one barrel, per ton of shale.

The next factor has to do with plant size and plant production. A ton of raw shale must be handled for each barrel of oil produced. It seems reasonable to establish, as a unit, a plant capable of handling 1,000 tons of shale per day; and with a present oil production, from wells, of 900,000 barrels per day, the smallest unit which we can consider for the shale industry as a whole is 100,000 barrels per day. For such production we shall need 100 of our 1,000-ton unit plants.

If it be asked why we must start on any such scale as this, the answer is plain. It is true that there now exist 10 or a dozen plants of capacity from 16 to 150 tons, in more or less continuous operation; but these are strictly experimental undertakings. A number of processes are in the way of being tried out, more as a laboratory proposition than under actual working conditions. Any one of three or four of these will produce results when the ordinary adjustments necessary to any new process have been made. It is in order to proceed on a small scale while making these adjustments; but after they have been made, the construction and operation of 50-ton, 100-ton, even 500-ton, commercial plants would merely delay the production of crude or refined shale oils indefinitely, producing no profits from which plants and operations might be expanded. The inventive period must run its course before capital can be enlisted; but when it has run its course, we must go into commercial operation on a commercial scale, and not on an experimental one.

The very fact that the experimental period has not reached its close makes it impossible to give definite estimates of installation and operating costs; we do not even know what process will come out on top, and if we did, we do not know what refinements will be effected in its application to cut initial costs and expenses. This uncertainty is made very evident when we glance at such estimates as have been put forward.

A New York industrial engineering firm insists that a profitable commercial plant will cost $2,500 per ton capacity. A Salt Lake chemist says he can put into shape for operation a plant, based on proved Scotch processes, for $1,000 per ton. A Denver chemical engineer who has got his experimental work fairly well along believes that he can install equipment, under his patents, for $300 per ton.

When it comes to comparison of possible expenses against possible revenue, the divergence of opinion is even wider. For one thing, estimates of the products vary, not only in amount, but actually in character. There will of course be gasoline, kerosene, lubricating oil, paraffin wax and fuel oil, all from the crude oil.

(*Continued on page 497*)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

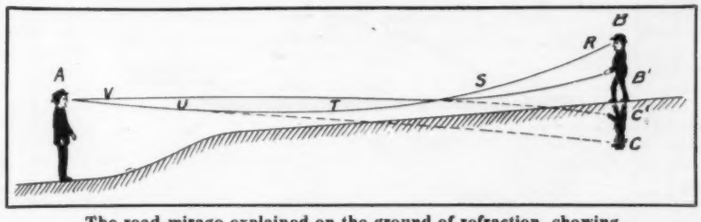
The Road Mirage

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the correspondence that appeared in your issue of October 26th, allow me to add a little to Mr. Du Shane's and your discussion of this phenomenon. It is a very common one in California. It has been my experience to drive for miles along the highway with all the road, from a few hundred feet ahead of the car and behind it to the horizon in either direction, appearing like a lake—with trees, houses and vehicles reflected just as Mr. Du Shane has observed in Ohio and Pennsylvania. The "water" appears to evaporate ahead of us, and on looking back it seems to close in upon the space through which we have passed.

As Mr. Du Shane's diagrams indicate, the favorable condition for seeing the mirage is when the line of sight is close to and parallel with the level of the road. If the day is only moderately dry and warm this line may be about 22 inches above the road; but sometimes, when heat and dryness are excessive, as is often the case here, the mirage may be seen from a height of six or seven feet. I think that if Mr. Du Shane will get his eye down to about the level of his spare tire, he will see the mirage even on a flat level road that has not the depressions shown in his drawing.

My theory is that the mirage is caused rather by refraction than by reflection from a heated layer of air immediately above the road. After the sun has been shining several hours the air above the road is heated by conduction from the ground; and when there is no wind or other disturbance the air at the ground is hottest, and is cooler higher up—the change in temperature being gradual as the height increases. The heated air has a less optical as well as actual density, so the light would follow a curved line.



The road mirage explained on the ground of refraction, showing why the image appears inverted

As the ray travels from R it passes from one medium into another of less density, and hence is refracted away from the perpendicular. When it gets to T it has been refracted sufficiently so that it is travelling almost exactly parallel to the surface of the ground. Under these conditions, even though the critical angle for the strata at T be extremely small, it is still large enough to cause total reflection. Then as the ray starts upward from U it is passing through a medium of increasing density, and is accordingly refracted toward the perpendicular. The ray, therefore, passes from B to A along the curved path shown; it comes to the eye at A in the direction VU and B appears to be at C. The image is seen inverted because a second ray, from a lower point of the object than B and travelling a path that brings it to the eye at A, starts at a less angle than the upper one, is refracted less on both its downward and upward passage, and finally reaches the eye more nearly horizontally, giving its source, B′ an apparent position above B. In the diagram, the refraction is greatly exaggerated to make room to show this second ray well distinguished from the first.

It is to be noted that A cannot see the feet of the object, nor anything else on the ground about that object, because all the light leaving the feet at an angle sufficiently great not to be totally reflected back to the ground from the under surfaces of the layers of air, will be refracted sufficiently to pass over the observer's head.

The fact that this mirage can be seen from different heights, depending upon the temperature, bears out this theory; for of course the greater the temperature the more difference in the density of the air immediately in contact with the road and that some distance above it; hence the more bending of the rays, and the higher the position of visibility for a given distance. The straight ray from B to A, through strata which are comparatively uniform, is not interfered with at all by the refracted pencil, so in addition to the inverted reflection beneath the true object, the observer likewise sees the upper portions of that object in its proper position.

SCOTT STERLING.

Half Moon Bay, Cal.

To the Editor of the SCIENTIFIC AMERICAN:

The road mirage is very common in the streets of some of our cities. I first observed it in Washington, on Pennsylvania Ave. around 20th St., N. W., in 1899. My first thought then was to make a memorandum of it for your correspondence columns, but having subsequently found that it can be seen there almost any sunny day, concluded that most people must be familiar with it. However, since your having devoted space to it indicates that this may not be the case, I append such observations as I have made.

At the time mentioned I used a bicycle to get around with, and as the mirage is visible mostly from the middle of the asphalt-paved street and not from the sidewalk, this may account for its non-observance by the majority. It consists in an appearance of wetness, by the blurred reflection of passing objects, on the pavement some 500 to 1,000 feet away. I have never noted that it cut off the lower part of the object, as observed by Mr. Du Shane; so this must depend somewhat upon distance and other conditions. It occurs almost entirely on asphalt-paved streets, occasionally on macadam roads. It is visible, moreover, not merely on warm, sunny days, but almost equally on cold gray days. In each case no doubt the sun is the heating agent; but in the latter case the heat is saved over from the last sunny day, continuing to make the air-layer immediately above the pavement sufficiently warmer to produce the total reflection. I have seen the mirage in Milwaukee, on asphalt; and in South Texas I have observed it, two or three times only, on an ordinary prairie dirt-road. It is natural that this mirage should occur more frequently in southern climates than in northern, hence it is probably more or less of a rarity in most of our cities.

While on this subject I may point out that the prairie mirage, whereby trees, buildings and other objects on the edge of the horizon, three or more miles away, are universally seen in summertime separated by a layer of sky from the ground, is just the opposite of the road mirage or of the desert mirage; to wit, the path of the visible ray is concave to the ground instead of convex. This kind of mirage is the same as that seen over water anywhere along the New England coast, and perhaps elsewhere. It indicates that the air next the ground is cooler than that immediately above it; but why this should be so I leave to some of your other correspondents to explain.

G. W. COLLES.

Rosharon, Tex.

To the Editor of the SCIENTIFIC AMERICAN:

I have read your description of the road mirage and have greatly enjoyed the same. Having lived in Ohio, near Wooster, for four years makes it doubly interesting to me. I never saw a mirage in Ohio, but several years ago read of one appearing in the outskirts of Toledo.

There is one point which I wish to dispute in Mr. Du Shane's description. I have seen many mirages in the Panhandle of Texas, and I deny that a hot day is necessary. Our best mirages are seen here between daybreak and sunrise, although at this altitude (3270 feet) the nights are cool enough to require us to sleep under bed clothing. Early spring is the best mirage season here. I can confirm your deduction that a smooth or hard surface is necessary, as plowed ground does not give good results, and on this account we are seeing less mirages every year. Many a morning I have seen hills thirty miles distant which are invisible ordinarily; and occasionally I get a peep at two towns, eight and twelve miles distant, respectively, which ordinarily cannot be seen because of their lying on lower ground. I have often wondered whether the mirages would be intensified in a hot climate, and hope Mr. Du Shane will try some observations at the time of day I have mentioned, to throw light upon this point.

M. F. D.

Plainview, Tex.

To the Editor of the SCIENTIFIC AMERICAN:

As regards the suggestion from Texas, since writing the letters which you published before, I have seen the reflection on cold days, but much closer to the surface of the ground and requiring a brighter sunlight. The long-distance mirages spoken of in the above letter are never seen in this part of the country, so far as I can learn; this is perhaps due to the broken surface, largely covered with trees, and the presence of more moisture in the atmosphere.

C. P. DU SHANE.

To the Editor of the SCIENTIFIC AMERICAN:

Perhaps it will interest you to learn that a scientific friend with whom I discussed the question of road mirages brought up in a recent issue of your journal tells me that he has often observed the mirage on the heated streets here in New York and Brooklyn in the summer. Of course it should be possible to see it; but there must be a limit somewhere, and it may be a contribution to show that that limit is north of our metropolis.

W. C. P.

Brooklyn.

To the Editor of the SCIENTIFIC AMERICAN:

I have read in the SCIENTIFIC AMERICAN of the 26th October, 1918, an article entitled the "Road Mirage," and it seems that such a phenomenom is rare in your country. In this connection it may be of interest to your readers to know that in Italy there is a country where the "Mirage" is characteristic, viz., the Strait of Messina. Looking from the Calabria coast the observer frequently sees the houses of Messina, a town on the opposite shore about 16 kilometres distant, reflected in the sea. The phenomenon is called the "Fata Morgana" and in the town of Reggio Calabria there is a road with this name, due to the frequent occurrence of this phenomenon when travelling along it. The reflection is so clear that the number of the windows of the Messina houses may be counted.

Your explanation of the phenomenon is quite correct; the only essential conditions to produce it is a very clear and calm atmosphere. In these conditions the atmosphere is composed of different layers of heated air. These layers have different refractory indexes and a ray is deviated from the straight line until it strikes a stratum at an angle which is too small to produce a new refraction and then we have the total reflection, the ray being perfectly reflected as in the optical prism.

Milan, Italy. C. PAVONE.

How Best to Make Airplanes Safe

To the Editor of the SCIENTIFIC AMERICAN:

In the correspondence column of the SCIENTIFIC AMERICAN, March 8th, 1919, the above subject is comprehensively treated. The writer agrees with Mr. Gaetan Ajello that the modern parachute is inadequate as a device of safety for aviators. After classifying airplane accidents into three categories: "those occurring at high altitudes, those at low altitudes (near landing) and those which are to be identified as fires," Mr. Ajello points out the causes of said accidents. He says the second class furnishes the overwhelming majority of cases for several reasons, and shows the parachute would be of no avail. Mr. Ajello suggests "a device that would save both the machine and its occupants." He continues: "Such a device should be attached at the most suitable point and must be within easy and immediate control of the pilot. It should consist of a collapsible frame covered with fabric rendered fire-resisting." Mr. Ajello further explains the operation and function of the device and his explanation is somewhat descriptive of a device which the writer has worked on for several years and now developed into a practical possibility. U. S. Patents are pending. It consists of collapsible, rigid, semi-rigid or non-rigid surfaces which gradually or instantaneously can be converted from non-resistant and non-weight sustaining planes into auxiliary (emergency) safety-planes, reducing speed and at the same time increasing the weight sustaining area of the machine as a whole. These safety planes may partly or wholly be put into—or be put out of—use at any time. This safety device has been developed integrally or as part of the flying-machine itself. The safety planes when in use increase by ⅓ or ½ if desirable the total surface area of the machine. When not in use they have no resistance excepting that of cables for their manipulation.

Form of the stationery glideplanes relating to camber, angle of incidence, aspect ratio of chord to span, gap, ailerons, etc., may follow approved scientific lines with reference to specific measurements in accordance with purposes for which airplanes are built, whether for speed or weight carrying, but the general form may nevertheless be made different, and in point of safety particularly, be made greatly superior to present "heavier than air" flying machines. Test flights of rubber-strand-propelled-models are not so difficult, but testing or demonstrating the control or manipulation of the safety planes on such models in flight is difficult indeed.

San Francisco, Cal. E. S. NELSON.

Our Marked Highways

How Their Marks Have Led and Misled the Innocent Tourist

By Avis Gordon Vestal

IN more than 9,000 miles of touring I have made the acquaintance of about 40 more or less important motoring routes to which has been attached the special dignity of a name. I have driven east and west from Chicago over the Lincoln Highway and have pursued the National Old Trails from end to end; as alternative routes I have sampled the "Black and Yellow" from Chicago to the Black Hills and the Yellowstone, and driven over the Pike's Peak Ocean-to-Ocean Highway; I am familiar with the Burlington Way and the Cannon Ball Trail; I have done a good deal of northing and southing over the Mississippi River Scenic Highway and the King of Trails that connects Winnipeg with Texas. In addition to all this, I have at times found it necessary to follow unidentified country roads, as in the western half of my own state (Illinois) when visiting places away from the main lines of travel.

Erecting 1,500 signs along the Lincoln Highway between Omaha and Salt Lake

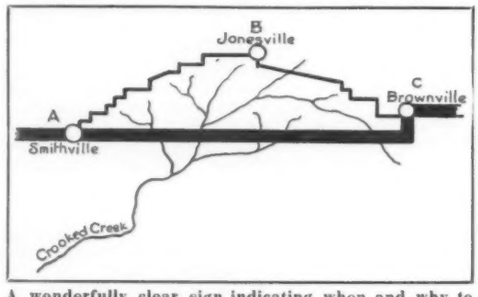
After all this experience, I must own that I feel more or less inclined to pass up the traditional classification of roads as "good," "fair" and "poor" and to regroup them according to whether the stranger can follow them with some idea of where he is and whither he is going, or whether he can only speculate on these points. In other words, there are marked roads and there are unmarked roads. Pursuing the matter further, among the marked roads there are roads which are intelligently marked and there are roads which are not; there are roads which are marked continuously and roads which are marked but intermittently; there are roads on which the marks are maintained and roads on which they are not.

The unchartered course requires frequent halts to ask local residents to point the path. Too often these directions are vague and confusing. We soon learned that it was the part of wisdom to ask at least two different informants—and then to seek a third for a deciding vote. But one often requires a signal when no human is within miles to give it.

As I see it, it is in recognition of this state of affairs that certain accepted motor routes between the several sections of our country have been dignified with names. It is in further recognition of the necessity for keeping the tourist straight in his tourings that a distinctive symbol has been adopted for each of these trails, and that this symbol has been more or less systematically and more or less conspicuously and at more or less regular intervals painted on telephone poles, etc., alongside the highway. The idea, well executed, is an excellent one. Following the painted poles is the surest method of finding the main towns, where motor and personal supplies may be had. It means commonly that the best topographic line has been drawn to avoid swamps, unbridged streams and steep hills. In the arid wastes of some western regions, the tenderfoot, even the rubber-tired tenderfoot, can, without blazoned trails, easily add to losing himself the perils of finding no water, no ranch, no garage.

Named and marked routes are still young in most parts of the United States. With their budding powers they couple certain chronic weaknesses. Even the best have their missing links. Too often, roads once designated are neglected until the markers become illegible, or new poles are set which do not collect their inheritance of symbols. Sometimes there are interludes of miles where local initiative has not yet been aroused to do its bit. Sometimes local rivalries between towns have resulted in painting unauthorized alternative routes without proper placards at the junction to indicate their true character. Other mean little competitions have led the citizens of some jerkwater community to tear down the highway signs and destroy them, or move them across to their pet branch of the road. A source of error in the Far West is the fencing in of once open grazing lands through which the trail formerly meandered. Another weakness comes in the setting up of new crossroads after the marking party has been through, making corners which confuse because of their lack of signs.

In general the trail is easier to follow through the country than in the towns. Crossings are fewer; if all corners are marked one can manage without markers between, though it is reassuring to pick up a symbol now and then to indicate that one is on the right track. Where painted poles are lacking a thoughtful farmer will sometimes paint the highway markers on his fence posts or mail box or even on his silo.



A wonderfully clear sign indicating when and why to take the detour that avoids the waterways

As most highways make frequent angles, one can never be certain, in the absence of a mark, that his proper course at any corner lies straight ahead, even though he knows that to be his ultimate direction. I have seen more than one crossroads with a single pole exactly at the corner. Does this mean straight ahead or turn? Even two poles may be set ambiguously. The placing of an arrow or a hand, or the setting of secondary marked poles beyond each corner but close enough to be visible from it, would resolve the difficulty here.

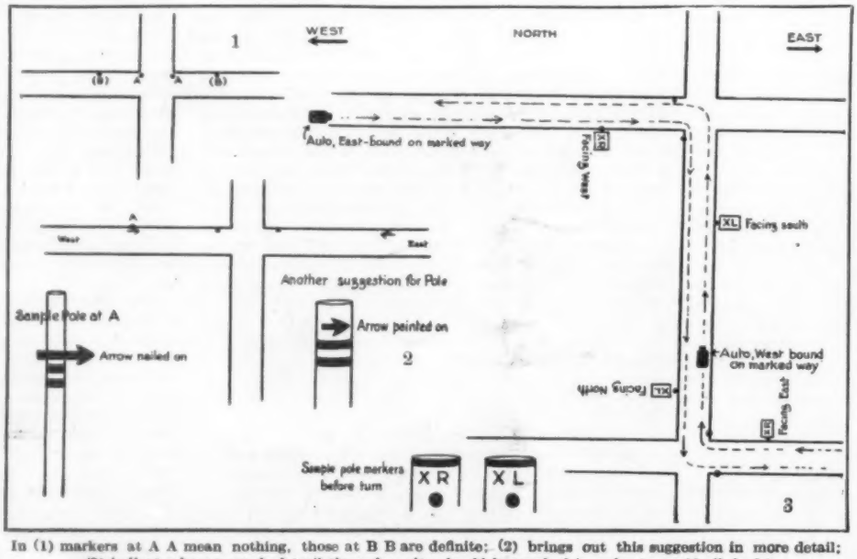
A symbol painted too low will be overgrown with weeds in the summer. Worse yet, it may meet a fate which I have observed along the Cannon Ball Trail. Poles originally marked with black ball and C at insufficient height, had decayed at the ground and been reset. In their new positions the marks were actually half buried, difficult to find when the ground was bare and quite out of sight when there was any grass.

On the straightaway course through the country one must slow down at every corner to read the marks and be prepared for a turn if need be. This could be eliminated by the placing of an arrow about 60 yards before each corner, to indicate that the course was not going to turn off. This arrow, or perhaps hand, may be painted on the pole above the symbol or it may be a separate silhouette nailed to the pole. When a turn to right or left looms ahead, the addition of the initial R or L should be made equally in advance of the corner to warn the driver to slow down for the turn.

An alternative route, of real service when properly designated, may become a frightful nuisance when its character is not plainly indicated. There may be a short and direct route across the hills and ravines between Smithville and Brownville, picturesquely wooded and quite passable when dry. This should be the main route. The second or optional route follows an indirect course via Jonesville, crossing but one of the many tributaries of Crooked Creek; it will be safer and really time-saving when the clay is wet. To make the loop a source of satisfaction rather than of disgust, the respective characters of the two routes should be indicated on the sign at the point of divergence. This might be done either by a sign that gives full particulars, or by some such scheme of graphic representation as that shown in the cut. Presumably, if the choice is left to chance, it is a fifty-fifty split that the motorist will make the advantageous selection; but it would be hard to convince him that the odds are not about ten to one against him.

There is another type of trouble frequently met along the "Black and Yellow" in Wyoming. The route consists of a winding course around an interminable series of buttes. As the land is unfenced, anyone can at his individual whim break a new route in the hope of avoiding ruts or finding a less steep grade; accordingly before nearly every hill the winding trail splits into three or more divisions, with no indication of which one should be followed. Ordinarily these branches would meet on the far side of the young mountain; but there is always the chance that they will actually diverge, never to meet. I don't suppose it is practicable to label as safe every detour which every motorist establishes through this country; but it should be practicable to label as unsafe those which lead nowhere.

A fault that causes much confusion along the Burlington Way is that the feeder lines are marked identically with the main route. Such lines, if it is felt advisable to label them as part of the main route at all, should use the symbol of the main line plus some additional distinctive mark. In the case of Lincoln Highway feeders the main-line symbol is



In (1) markers at A A mean nothing, those at B B are definite; (2) brings out this suggestion in more detail; (3) indicates how a crooked trail through a city should be marked in order to avoid all doubt

How to keep the tourist on his track

used, with an arrow pointing in the proper direction, and the words "To the Lincoln Highway." This seems to be ideal.

For convenience in night travel the palm must be awarded to Iowa's Great White Way. Of course if all marked routes adopted the same three-foot white band on their poles, they could not be a distinguished from one another; but enough modifications should be possible to go around.

The telephone pole is the universal carrier of highway marks—where telephones exist. Where poles are lacking, highway associations with sufficient funds have placed metal poles, well anchored by wings below the surface. The merit of durability is here supplemented by that of precise location. Tree trunks and fence posts, as well as the balustrades of bridges and culverts, also serve; but they lack the last-named advantage. When all these fail, as along parts of the Yellowstone Highway, boulders have been laid at forks and painted yellow. In unfenced grazing lands, short wooden or metal posts have sometimes been placed to carry road signs. These the cattle have used as rubbing posts until the signs and even the posts are demolished. So without at all excusing the highways organizations which have failed to toe the mark, it will be seen that they have their problems, and that it ill becomes the motorist to abuse them indiscriminately without stopping to consider what these problems are.

The motorist's difficulties in driving through a town or city are somewhat different from the ones encountered in the open country; yet they are none the less real. If all towns were traversed by a single business street in a single straight course the matter would be simple enough; but this is far from being the case. The routing of the trail through towns is highly individualistic and most annoying. It may pass by within sight of a town or out of view. It may cross the town in a bee line or in a succession of angles. The motorist's course may be approximately diagonal, or he may be led unwillingly into town and out again in a loop paralleling his inward course. He may even be obliged to circle around Podunk and come out again by the very road that brought him in.

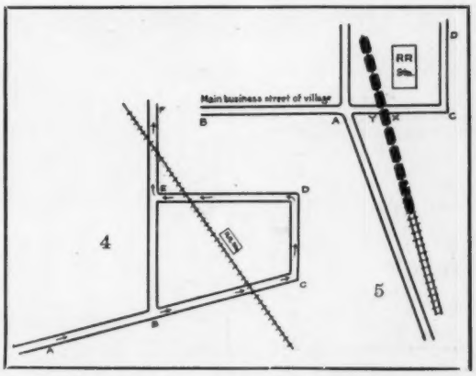
I find that one is led into an unnecessary number of small towns which are not really upon the proper course. When enough towns lay directly upon our way to provide for all our purchasing needs, we would frequently swing alternately north and south of the direct line connecting the county seats. Why not legitimize this procedure by providing recognized loops, so that the long distance tourists with no interest in the villages could ride straight ahead, while the local traffic which must enter the town could use the alternative route? As an illustration of this suggestion, I show a sketch of our actual route through an insignificant Kansas town, where we were obliged to ride out of our way and twice cross a railroad at grade, although there was an equally good street which would have taken us directly on our way had it been so placarded that we could have found it.

Every town means some delay if a detour must be made to take it in. In addition every village means slowing down; and the smaller the settlement the slower the speed demanded. In a large city an absolute halt may be required at each of dozens of street crossings. As towns in general are more poorly marked than country roads, each block means the possibility of getting temporarily lost. A town with gaps in its marking is as bad as one with no marks at all. In Cedar Rapids, for example, we followed the brilliantly painted Red Ball symbols into the main business district, where they ceased abruptly and left us stranded. We wasted half an hour in search of a policeman or a citizen who could direct us, and finally hit upon some dim old marks in another part of town that led us safely out. Incidentally, it didn't benefit the town any; we had intended to make some purchases, but the delay put us back so that we had to let them go for the next day and another place.

A service that far too few towns add to their marker poles is the arrow or the R and L sign on poles between corners. Forewarning of turns or straight paths is as desirable in town as in the country. Where "Turn to the Right" signs are used they afford an ideal place for the posting of highway symbols and other detailed information. Columbia, Mo., on the National Old Trails, is conspicuous in this respect. In the same breath might be mentioned the admirable night driving along the course of the Lincoln Highway through Baum Boulevard, Pittsburgh, where the street-lighting fixtures carry the highway symbols on their globes. This is a feature that deserves wide copying.

Where the trail through the town crosses the railroad, it is desirable that the highway marker be set close to

(Continued on page 498)



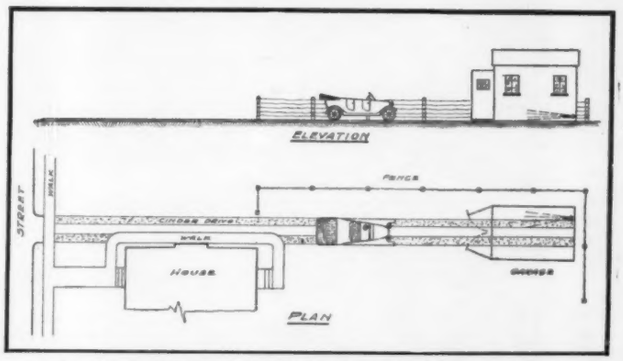
In (4) is shown how the tourist is forced, by the road marker, to make a long detour through a village when a direct road B E was available. In (5) the marker at X is hidden by a train standing at the crossing; there should be one at Y as well.

The confusion of the tourist, as developed by two small Western towns

Lighting an Automobile Driveway

By Evan J. Edwards

IT is not at all uncommon to find an automobile driveway to a private garage in the back yard situated between a house and a gate or fence post. Under such circumstances, and more particularly in wet weather, accurate steering is necessary while the car is being backed out to the street.



The situation that makes backing down the driveway difficult

The problem of lighting such a drive at night has in this instance been solved by mounting on the rear wall of the garage at a height of one foot from the ground and a distance of six inches outside the left side of the drive, a regular spot light intended for the windshield. The light is mounted low so that it may shoot under the fenders and running-board and light the drive to the rear of the car. In attempting to use this method, there may be trouble from objects in the path of the beam casting long shadows not parallel to the drive, thereby causing some confusion. This can be avoided by placing a small post a foot or so high so that it will cast a long shadow exactly parallel to the drive, thereby providing a definite and accurate line to steer by when backing out.

The spotlight may be operated from a city lighting circuit by the use of a regular adjustable voltage toy transformer for reducing the 115-volts alternating current to the 6-8 volts required for the lamps.

This arrangement has been in use for some time and has been found very satisfactory.

The driveway illuminated from the rear wall of the garage, so that backing out becomes simple

The Strength of Commercial Liquid Glues

MOST of the commercial liquid glues are manufactured from the skins, heads, and swimming bladders of fish. Others are made by special treatment of the glue extracted from the hides, skins and bones of cattle; some for special uses are prepared from starch, from various natural gums, or from casein.

At the Forest Products Laboratory tests were made by inspectors on a number of these liquid glues, which showed that they differ very widely in strength. Some of them are so weak as to be entirely unsuitable for woodworking purposes, while others compare favorably in strength with the "hot" glues. The glues tested varied from one which exerted a binding force of less than 50 pounds per square inch to one with an adhesive strength 60 times as great, or more than 3,000 pounds per square inch.

Liquid glues may be tested by gluing together pairs of specially selected hard maple blocks, placing them in a testing machine, and measuring the force required to shear them apart. About 200 specimens, representing 26 different glues, have been tested in this way at the Laboratory. According to the data thus obtained, a high grade liquid glue should have an average shearing strength of 1,700 or 1,800 pounds per square inch.

In addition to uniform high adhesive strength, it is evident that certain other characteristics are desirable in a liquid glue. When spread upon wood surfaces, it should "set" and dry rapidly. In its container, it should remain fluid and workable at all ordinary temperatures. It should be elastic and shock-resistant. It should not be unusually susceptible to the action of high temperatures, high humidity, molds and bacteria.

The study gave evidence that the strength of liquid glue, like that of "hot" glue, depends largely upon its "body" or thickness, or, strictly speaking, upon its viscosity. Of 11 liquid glues examined, the thickest or most viscous glues showed the greatest adhesive strength.

Piling of Concrete Pipes

PIPES made of concrete are a new development in some quarters and have been replacing cast-iron pipes. They are now being used instead of wooden piles in the construction of wharves in Tasmania. A Tasmanian paper reports that the first of 600 concrete cylinders was turned out recently, the cylinders to be used to build the wharf inside the new breakwater at Burnie for the accommodation of deep sea vessels.

The plant has been installed in the blockyard at the harbor, and the proceedings were in the nature of a trial. The concrete cylinders are 10 feet long by 4 feet 6½ inches in diameter, the concrete being 12 inches in thickness.

To produce them a steel cylinder is placed on four wheels, and driven by an electric motor, revolving at the rate of from 250 to 300 revolutions per minute, the concrete is thrown in, and the centrifugal force thus produced gets rid of the water. It takes about a quarter of an hour from the time the mold is set in motion until the concrete cylinder is ready for removal, which is then lifted to a storing place by a crane. Three 12-inch pipes can be turned out in seven minutes. The firm make down to 4-inch pipes, and the molding cylinders revolve at a much more rapid rate for the smaller work, decreasing in speed with the increase in the size of the pipe. To obtain the necessary height in constructing the wharf, the concrete cylinders will be placed on top of each other, cemented together, and secured by an 8-inch steel band on the outside at the joint. The hollow space in the cylinders will be filled with sand.

The pipe company secured during October and November last orders for large quantities of concrete piping. One municipality has ordered 5,400 feet for 250 pounds working pressure. Gold mining companies have ordered piping for pressures from 150 pounds down to 50 pounds. Other orders have come in from country districts for culverts, drains, etc. Some excellent test results have been obtained with pipes. Two lengths of 4-inch pipes jointed together with a collar joint have been tested to 360 pounds per square inch without showing any signs of leakage or sweating.

Pulling an H. S. 1 type of flying boat up the runway at the L'Aber Varch U. S. Naval Air Station, France

Assembling the H. S. 1 and H. S. 2 types of flying boats at the Brest Naval Air Station, France

The Seagull Flies

Special Factors in Connection with Naval Aviation

By Paul J. Haaren

WHEN aviation is the topic, the picture conjured up by the popular mind is that of two pursuit planes engaged in a thrilling air battle over the lines in France. The reading public have heard and read of nose-dives, tail-spins, renversements and all the other tricks that belong in the bag of the pursuit pilot. They have seen the pictures of that hero of the day, the ace, and read of his wonderful exploits in the air. Their imagination shows to them formations of Handley-Pages bombing towns on the Rhine, Capronis destroying Austrian bases across the Adriatic, De Havilands swooping low, torn through the air by the pull of a Liberty motor and scattering death and demoralization in the shape of machine gun bullets throughout the network of German trenches.

Water flying has not had the publicity of land flying. Naval aviation is a term not suggesting such a clear picture to the Liberty Bond buyers' mind. They have heard of it. Quite a few of them recognize the uniform of the naval aviator when they see it on the street. To the greater majority, however, the naval aviator is a marine. Naval aviation has something to do with the Navy, the name itself suggests that much, but just what is done, how they do it and what it is done with is more or less of a mystery to them.

They speak of hydroplanes as of aircraft, not knowing that a hydroplane is nothing but a type of speed boat that has nothing to do with flying. What they really mean to refer to is the hydroairplane. The word hydroairplane itself is now obsolete. Water aircraft are either seaplanes (modified airplanes with one or two floats in place of a landing gear), or flying boats, having boatlike hulls with wings attached thereto.

The progress in water flying has been fully as rapid as that in land flying. The type of planes used by the Navy has been changing constantly and is even now undergoing rapid modification.

The earliest experiments were made with land machines on floats. These were crude affairs and not very successful. Then the boat type was originated by Curtiss. This proved very satisfactory as regards its flying qualities and handling on the water. For instruction purposes, however, it did not quite meet the demand. It was tricky. A crash usually meant death or permanent injury. It did not readily permit of a student mechanically checking his position of flight. In short, it was a difficult type for a student flier to master in any reasonable amount of time as compared with other types.

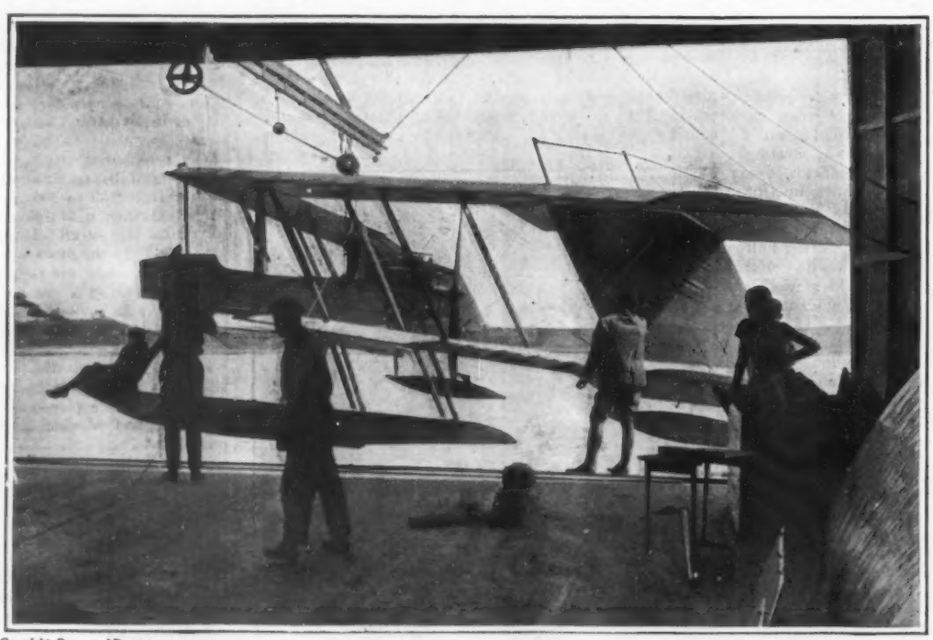
Finally a machine was evolved which had the qualities of the land machine as regards handling in the air, proved satisfactory on the water, and made an ideal machine for instruction purposes. This machine was adopted for elementary training and is still used for this purpose. For ease of control, maneuverability and durability it has given entire satisfaction. The student mastering the flying of this type has laid a good foundation in the principles of flying and easily learns to fly any other type of water machine. In appearance it resembles a land machine mounted on a single pontoon or float, with small wing-tip floats in place of the wing-tip skids of the land plane. In the air it handles exactly as a land plane but is sluggish on the controls. It "stunts" with absolute safety, but does not come out of abnormal flight positions as quickly as the land machine. Of course, it can only be used in protected waters, not being able to withstand waves of any height.

A double pontooned, heavier type of seaplane was also developed for use in bombing and ocean patrol work. This type was used quite extensively by the British Royal Naval Air Service in the early years of the war with good effect. The main disadvantage of this type was its inability to withstand any sort of a heavy sea. The struts supporting the main body of the plane on the pontoons would buckle and break with the least extra strain. The pontoons themselves were necessarily of such light construction that they also would split in a hard sea landing. In the event of motor trouble while on a patrol the result was usually a smashed plane and more than often a lost plane, together with the pilot and his observer.

The frailness of this type of seaplane led to the adoption of the boat idea. Modifications were made of the F-boat hull. It was greatly enlarged and improved and it remained for the British Royal Naval Air Service to make the first successful use of the Porte type of boat hull for heavy sea duty. At first these boats, having an enormous wingspread, were used with two Rolls-Royce motors. With the appearance of the Liberty motor, however, several sizes of these boats were built using one, two and three Liberty motors of the low-compression type. These new types met all the conditions to which a sea-going aircraft is subjected admirably and are now in use at home and abroad for patrol and other duty. The enormous wingspread of these boats rendered them very stable in the air and on long flights it was the custom of many of the pilots to lash the control bridge and wheel, letting the thing fly itself. The control of these boats when maneuvering, however, depended as much on main strength as flying ability in the pilot.

This condition, of being "hard on the controls" is due, of course, to the enormous size of the controls themselves. Upon the surface presented to pressure does the ease of control depend. The rudder is as large as the sail a small boat would carry. The ailerons would compare in size with the wings of a small scout plane. Many methods have been tried, and are now meeting with success, of easing the stiffness of these controls. The gearing of the ailerons with the control wheel proved satisfactory but entailed much more manipulation of the wheel in maintaining lateral balance or when banking in turns. Several types of Servo motors have been tested. Of these the mechanical system of Servo control has proved the best. It is simple, absolutely dependable and operates easily. This is probably the type that will be installed on all the large flying boats.

The radius of operation of these boats is quite large. The smaller, with one motor, has a fuel capacity of a little over five hours. The distance covered would depend on the direction and velocity of the wind, but figuring the speed at 60 miles an hour and the weather conditions to be normal, this would allow of a continuous flight of 300 miles. The larger boat, double motored, has a much larger gas capacity, carrying enough fuel to last



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At the Boston Aviation School. Hoisting a Burgess-Dunne machine out of the water and running it into one of the folding hangers

nine hours. The larger boats are slightly faster than the single motored boats and thus, with their increased gas capacity could cover 600 miles or more.

Of course, continuous flights of this length are seldom, if ever, attempted. But it is a comforting knowledge to know that you have a margin of hundreds of miles in your gas tanks when you are a hundred or so miles at sea.

These boats are flown, as becomes a naval craft, on strict principles of navigation. There is not the least bit of guesswork attached to it. Navigation is a subject that the student naval aviator cannot well afford to neglect while at ground school. This was well impressed upon us in our student days. I remember a talk given us when at ground school, by a Royal Naval Air Service pilot, on what we may expect and what was expected of us when we got abroad. The speaker, a true Britisher, but of Irish origin, still retained a bit of the brogue of his native soil. At times it was a little difficult to understand him, but one thing we did remember of his talk was, to put it in his own way, "If you dawn't knaw your navigation you're nawt worth a dom."

It is the duty of the navigation officer of the station to figure out the courses which the pilots are to follow on their patrol. This necessitates a knowledge of the speed and direction of the wind, speed of the craft flown, deviation of the compass due to the steel in the plane and the variation of the compass in the particular locality where the flight is made. The latter two conditions are taken care of when the compass is adjusted by the plane crew. This does not free the pilot of all calculating, however. The wind might shift, its velocity might increase or diminish thus changing the allowance that must be made for drift. It is usually the assistant pilot who attends to the corrections to be made during the flight. For this purpose he uses a Battenberg disk, a mechanical contrivance which indicates the course to be followed, if it is operated correctly. The pilot notes the corrections in the course to be followed and maneuvres his plane accordingly.

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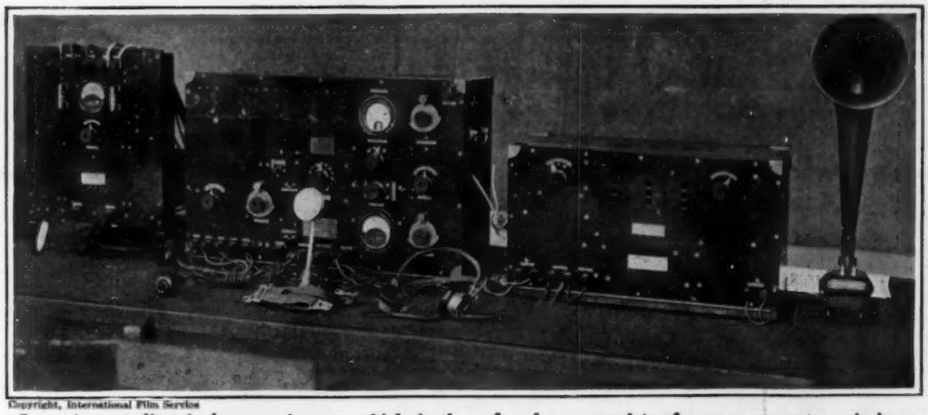

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Some Army radio telephone equipment, which, in the order shown, consists of a wave generator, wireless telephone transmitter and receiving set, vacuum-tube amplifier, and loud-speaking telephone

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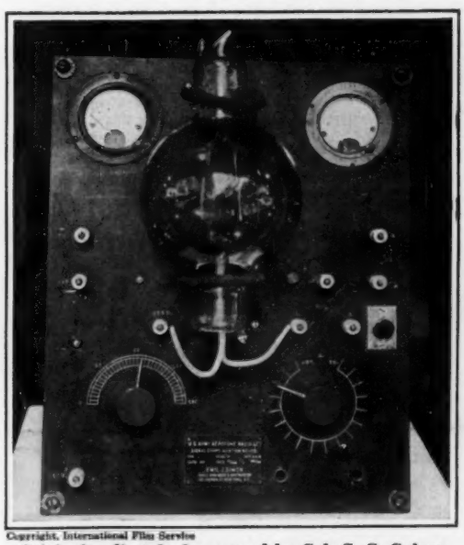
Loud-speaking telephone together with a multi-step vacuum-tube amplifier

The Martynside Trans-Atlantic Airplane

WHILE the trans-Atlantic Sopwith and Short machines were illustrated in our issue of April 26th, together with a complete description of those machines as well as the Martynside, it was impossible at the time to illustrate the last-mentioned type. Since then, however, the accompanying photograph of the Martynside trans-Atlantic biplane has been received from Newfoundland.

The Martynside, which will be used by Raynham and Morgan, is more or less like the famous Martynside F-4, a machine of a type which was never used on active service, although a year before the end of the war it was by some miles per hour the fastest, as well as being the highest climbing, airplane in the world. Fully loaded the trans-Atlantic 41-foot span Martynside weighs about 5,000 pounds, and carries 360 gallons of gasoline. The cruising capacity with a 20-mile wind against it all the way is easily over 2,000 miles. However, the airmen do not expect to encounter adverse winds for any great stretch, and, indeed, they are counting on favorable winds to increase their speed. In calm air the Martynside makes about 125 miles an hour, as compared with about 106 for the Sopwith after dropping its landing gear. It is equipped with a Rolls-Royce "Falcon" engine of 280 horse-power.



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Original radio telephone used by Col. C. C. Culver at San Diego, Calif., in 1916

Recent Novelties in Public Speaking

WONDERS have been wrought in public speaking within the past few weeks, thanks to the intensive application of the vacuum-tube amplifiers and the loud-speaking telephone. Indeed, during recent Victory Loan ceremonies, the amplifying and loud-speaking telephone equipment has made it possible for a speaker to address a crowd of tens of thousands of persons, extending for more than a quarter of a mile from the speaker's platform, despite all city noises. Again, public speeches have been transmitted by means of the wireless telephone through many miles of space to an expectant audience. Finally, it is possible at this very moment for anyone to deliver a speech from his drawing room in New York City to 50,000 persons in Chicago—if the speech is worth the expenses involved.

An interesting application of long-distance public speaking has been a feature of New York's Victory Loan campaign. Along a five-block stretch of Park Avenue, which has been elaborately decorated with plaster columns, flags, captured guns, and even two pyramids of German helmets, there have been installed some 102 loud-speaking telephones. Each telephone is provided with a phonograph horn, and is suspended from a cable stretched across the thoroughfare which has been re-christened Victory Way for the duration of the campaign. Several loud-speaking telephones are suspended from each lateral

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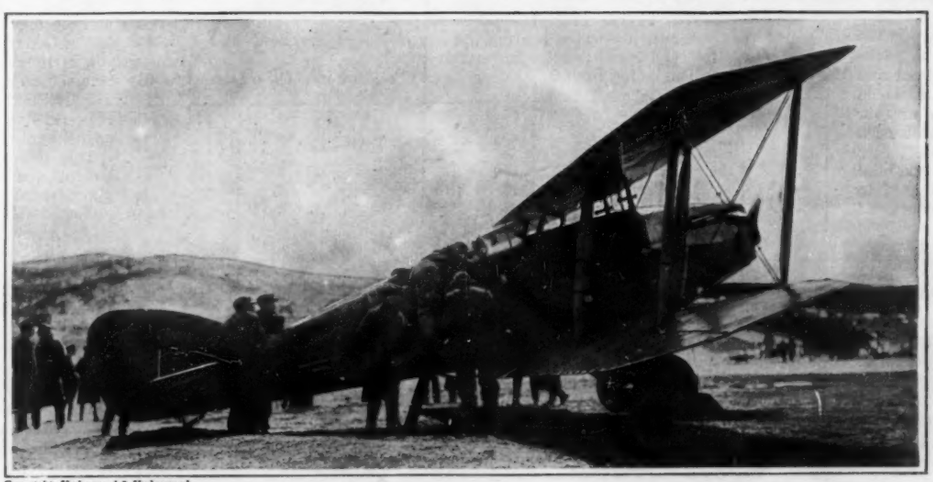
Row of loud-speaking telephones installed during New York's Victory Loan drive



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The Martynside trans-Atlantic airplane "tuning up" at Newfoundland, preparatory to the great flight

Mechanical Equipment of the Farm

Latest developments in agricultural machinery and practical suggestions for the farmer

Conducted by HARRY C. RAMSOWER, Professor of Agricultural Engineering, Ohio State University

Roller Bearings in Farm Machinery

THE use of roller bearings in various types of machines as a means of decreasing friction has been growing apace in recent years, but the great field of farm machinery, save the tractor, remains almost untouched. In a few machines, notably the mower and the binder, roller bearings have been used in a small way for several years, but one company now enters the field with a binder completely equipped with such bearings.

In Fig. 1 is shown the main frame with master wheel bearings A, secondary shaft bearings B, counter shaft bearings C, chain tightener sprocket bearings D and E, and reel drive shaft bearings F. Note the ball bearings in master wheel, secondary and counter shaft bearings used for the purpose of taking end thrust.

Fig. 2 shows the roller bearings of the packers and packer shaft and Fig. 3 shows the same in the bearings of the upper elevator rollers. In addition there are roller bearings in the grain wheel and other canvas rollers not shown, making a total of thirty-two roller bearings.

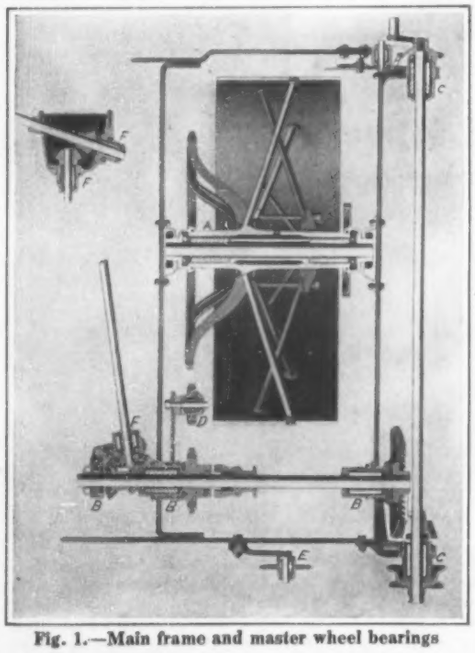


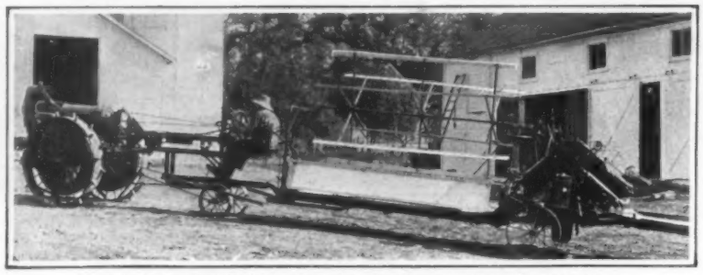
Fig. 1.—Main frame and master wheel bearings

Without question roller bearings will materially decrease the draft and, in addition, they require much less attention for lubrication purposes. In the grain binder, for example, the canvas rollers, the packer and pitman shafts run at a relatively high speed and thus require frequent oiling. The binder as a whole should have its parts oiled three or four times a day. Roller bearings will need oiling but once or twice in a season.

Just how far roller bearings will be used in farm machinery is a question hard to answer. Combination rolling coulters and jointers for plows are now being equipped with roller bearings as are certain bearings in grain threshers. They will in time be used in sulky plows, in cultivators, in grain drills, in disk harrows, in feed grinders, washing machines and possibly numerous other machines where reduction of draft required to pull them or power to drive them is an item of consequence.

The increased cost of the machine, due to the installation of roller bearings, will act to retard development in this line, but some progress will surely be made in the years immediately before us.

A photograph of the binder discussed is shown herewith. It has a 10-foot cut and is designed as a tractor binder. There are several features aside from its roller bearing equipment that are worthy of special notice. It has overhead packers as shown in the picture. This arrangement, it is thought, will tend to prevent the clogging of the deck, which frequently occurs in the horse-drawn binder. It should be remembered that a binder head must work faultlessly if it is to care for grain supplied by the 10-foot swath. The tyer-shaft is speeded up in this machine to enable the head more quickly to discharge the bundle.



Ten-foot tractor binder completely equipped with roller bearings

The bundle carrier, too, is unique. As shown, it is a platform equipped with a rolling canvas. This canvas is operated by sprockets and a chain. When loaded with bundles the operator throws a clutch into engagement, which operates the canvas and quickly discharges the bundles.

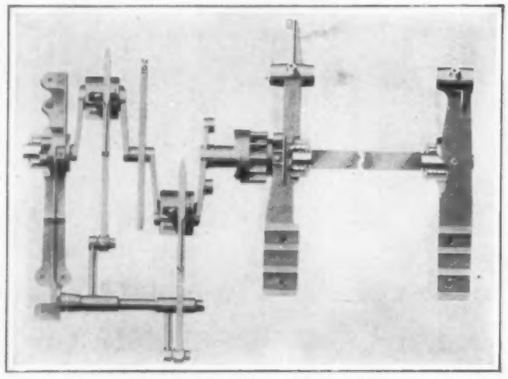


Fig. 2.—The packer and packer shaft bearings

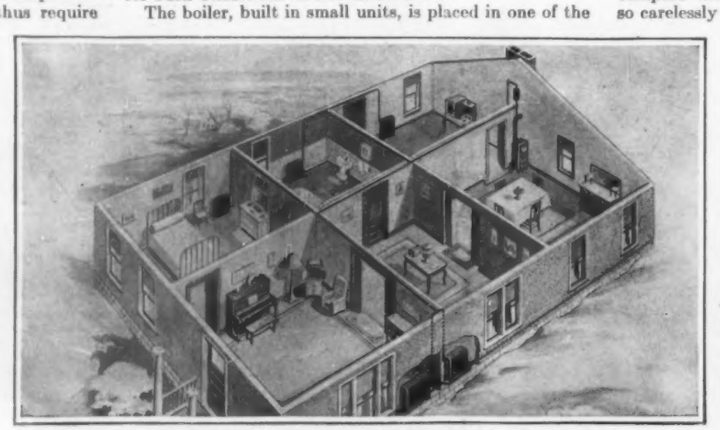
A New Idea in Heating Systems

IN many sections of the country it frequently becomes necessary to erect farm houses without a basement, or cellar. To heat such a house it has been necessary to use stoves in the several rooms. A modification of the common hot-water heating system has been arranged for such conditions as shown herewith.

The boiler, built in small units, is placed in one of the rooms and serves as a stove for that room. Pipes then lead from this boiler to radiators placed in adjacent rooms. The first line of pipe is taken upward to as high a point as possible, where an expansion tank of small capacity is placed. Each radiator has a connection to the return pipe line leading back to the boiler.

While the pipes may be concealed within partitions, this is scarcely practicable where the installation is made in an old house. When the pipes are in full view a couple of coats of aluminun paint makes them very presentable and, in fact, scarcely noticeable.

With such a system the circulation is positive and an even distribution of heat is assured in all rooms. Add to this the remarkable convenience of having only one stove to heat the whole house and its advantages are clearly seen. The stove is trimmed in nickel and is quite attractive. It can be built up in units so that its size can be gaged according to the number and size of the rooms and the exposure of the house



Heating system for a house without a basement

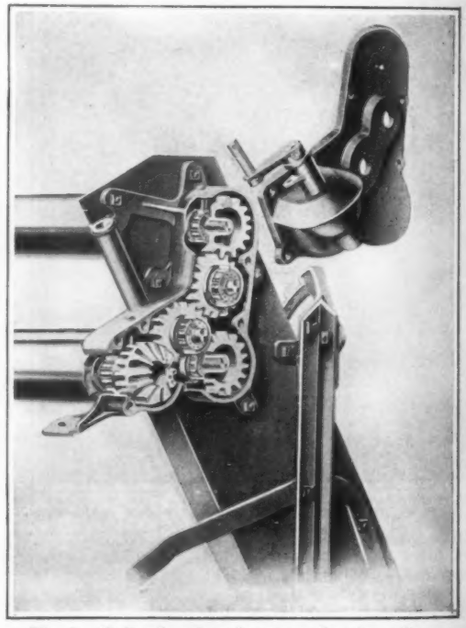


Fig. 3.—Roller bearings in upper elevator rollers

Effects of Attachments on Quality of Work and on the Draft of Plows

WITHOUT question plowing is the fundamental field operation on any farm. No single task can compare with it in importance. No task is generally so carelessly done. This condition is due to two causes, namely, lack of pride in one's work and lack of knowledge concerning the equipment and adjustment of the plow.

It is difficult to understand how one can be satisfied with careless plowing. The appearance of a recently plowed field is an almost infallible indication of the pride and neatness of the farmer in all his work. A plowed field with scattered trash on the surface, with grass growing up between furrows, with corn stalks sticking out of the ground here and there, indicates an attitude that is not wholesome, to say the least.

It is impossible to do a satisfactory job of plowing without attachments of some kind. Available attachments are the jointer, the cutter, or coulter, and the beam wheel for walking plows. The attachments to be used will depend upon the condition of the field to be plowed.

(Continued on page 500)

Remarkable Example of Camouflage

TO the southwest of Montdidier, which marks the farthest westward advance of the Germans in the last year of the war, there is a tall stone arch bridge. As this was a very conspicuous structure and one sure to attract the attention of enemy bombing planes French camoufleurs were given the task of making the bridge melt into the surrounding landscape. This was not as difficult as might seem. Viewed from the ground the bridge was conspicuous because of its gaunt height, but from an airplane objects on earth have no height everything is flat. All that was needed then was to clothe the bridge with "grass" so as to correspond with surrounding vegetation. By "grass" we do not mean natural vegetation. Real grass and branches were used in certain camouflage work, but the material had to be renewed daily because of the wilting of the leaves. A substitute for such perishable stuff was made of canvas and netting painted a leaf green. After the lesson had been learned that the green of the artificial "grass" must be not merely a visual match of the natural leaf green but also spectroscopically the same, enemy airmen found great difficulty in distinguishing objects covered with artificial verdure. In the case of the Montdidier bridge the clothing of "grass" produced a most picturesque effect giving the structure the appearance of an ivy-covered ruin.

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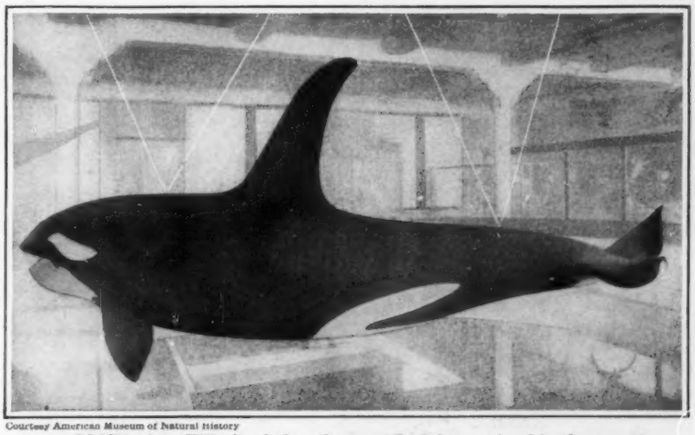
Not an ivy-covered ruin, but a cleverly camouflaged bridge

The "Killer" Whale

THE American Museum of Natural History has recently placed on exhibition a life-sized model of a "Killer" whale or "Orca" which is one of the most ferocious animals that inhabit the sea.

It will attack any living being within its reach, be it fish, flesh or fowl. The animal grows between 20 and 30 feet in length and its mouth is armed with teeth. All other whales are afraid of him. even the great sulfur-bottom—the largest animal the world has ever seen. Frequently these giant whales are captured with badly multilated flippers, evidently the work of "killer" whales. Apparently their only defence is in flight. The big gray whale is so afraid of the orca that it becomes paralyzed when attacked. The orcas are said to be particularly fond of the tongue of the whale. A number of them will attack a gray whale, worrying it until it opens its mouth, when they will dart in and bite off its tongue. Seals, porpoises and fish are the principal food of the orcas. The seal are not even safe when they are ashore; for at any moment an orca may dart out and seize them if they are near the water's edge. Birds too are captured in this way or when swimming. An orca has even been known to attack men who were on a large cake of floating ice. The whale repeatedly hurled itself upon the ice in its efforts to reach the men.

Apparently the orca has nothing to fear. He is not hunted by man because his blubber contains little oil, and so he is free to roam the seas, a terror to all its inhabitants. He may be found in all oceans, but is more frequently seen in the northern Pacific waters.



Courtesy American Museum of Natural History

Model of a "Killer" whale—the most ferocious animal in the sea

A Famous Great Lakes Steamer

THOSE of us who visited the World's Fair at Chicago will remember a large passenger steamer of unusual design, which carried great crowds of passengers between Chicago and the Fair grounds. We refer to the whaleback "Christopher Columbus," which forms the subject of the accompanying illustration. That was 26 years ago; and it will interest some of us to learn from its designer, Mr. Alexander McDougall, that this vessel, enlarged by the addition of a third passenger deck, is still in active service, and, we are told, is capable of making its original speed of 20 miles an hour.

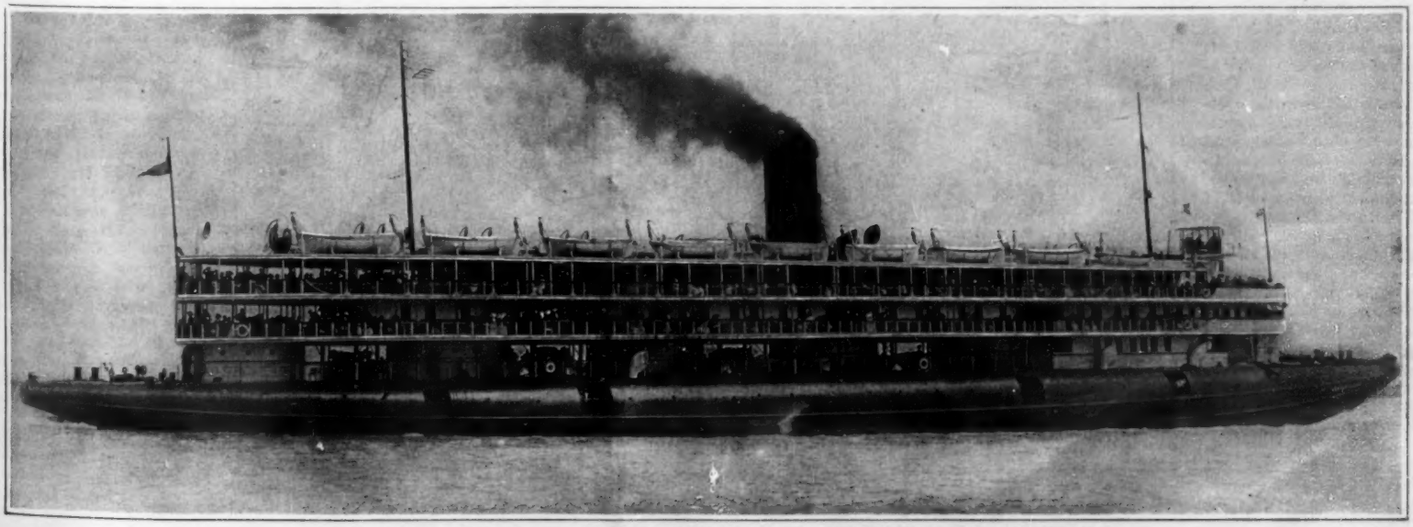
The whaleback ships were built to embody certain ideas of Mr. McDougall as to the form of ship which would handle itself most comfortably and with the least degree of punishment in heavy weather. Pitching and rolling are due to the sudden immersion of certain portions of a ship (forward, aft, or on either beam) due to the action of the waves. This causes a temporary increase of the displacement of the ship at the points affected, with powerful lifting effects upon the vessel, such as pitching when the seas are running fore and aft, and rolling, when they are abeam.

McDougall, as the result of his experience in towing barges, had noticed that a deeply-loaded barge with practically no freeboard, rode very steadily; but that as soon as the load was damped, the vessel was roughly handled by the seas.

And so the whaleback was evolved. A whole fleet of cargo boats of this type was built, and now and again they may be seen in New York Harbor, where at a distance they are suggestive of the German type of submarine. When they are in the loaded condition, the seas pass freely across their rounded decks, and there is a marked diminishing of the pitching and rolling as compared with the standard type. The turret freight ships may be regarded as embodying to a limited degree the principle of the whaleback.

The "Christopher Columbus" was built in 1892, and her construction was a remarkably rapid job. Even for these days it would be fast work. The contract was signed August 26th, 1892, the first steel was delivered at the yard September 7th, and the ship was launched with boilers and machinery aboard December 3d, a total of 87 days. The ship measures 365 by 42 by 25 feet.

The passenger accommodations are on the two upper decks, which are carried upon six circular turrets or towers of steel. In heavy weather any seas that come aboard pass entirely across the ship. She was designed to carry 5,000 day-passengers and at the Chicago Fair carried a total of 1,700,000.



The "Christopher Columbus," a famous Great Lakes steamer, built in 1892 and still in service

Dimensions, 365 ft. x 42 ft. x 25 ft. Passenger accommodation by day 5,000. Speed, 20 miles. Built on the once popular whaleback lines

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

The Manufacture of Carbon Electrodes

THE pioneer work in this field was done by a Frenchman, Carré, about 1876. At that time the principal demand was for use in electric arc lights. The development of the electric furnace, however, changed this; in fact, following the outbreak of the war and the increased demand for special steels, the use of electric furnaces in Great Britain expanded to a point where the shortage of electrodes was the limiting factor, the more so since England was to a large extent dependent upon foreign supplies of the materials employed in manufacturing them.

As is well known, electrodes for the electric furnace are of graphite or amorphous carbon, the former having the higher conductivity and being the more expensive—though the price even of the cheaper electrodes of amorphous carbon is now well over 40 pounds per ton. While the electrode consumption of the modern furnace is usually stated as about 10 pounds for each ton of steel produced, it is a fact that the actual consumption, including breakages, averages well over double the figure mentioned. The consumption when melting brass, for which purpose the electric furnace has been tentatively used in the United States, is only a small fraction of this; but, nevertheless, the cost of electrodes is an important feature of electro-metallurgy.

In the making of these members, extensive equipment is often required for grading, crushing, grinding and screening the raw materials—coke, charcoal, anthracite, lamp black, retort carbon, tar and petroleum residues, natural graphite, etc. After crushing the material is mixed with the binding material, usually tar or pitch, and then kneaded in steam-jacketed mixers. When necessary, calcination to remove gases and oily sub-

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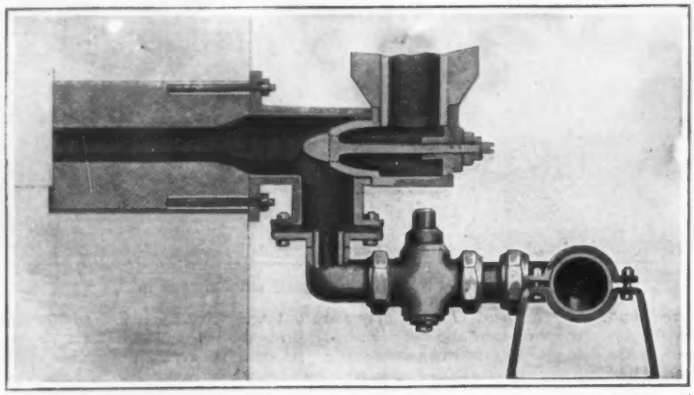
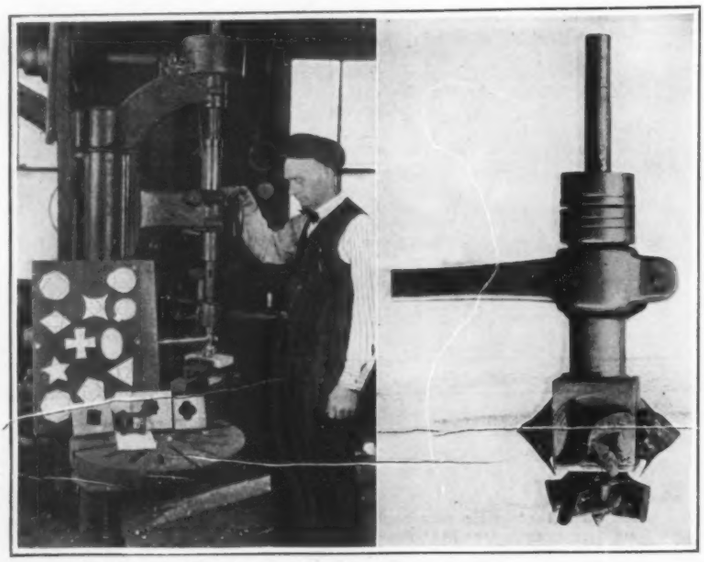


The fan-air burner used in the furnace for annealing carbon electrodes. Air supply above, gas below

Drill for Boring Square and Patterned Holes

A COMMON method of boring a square hole in wood is to have a rectangular cutter mounted on the bit so that it will not turn, but will follow the bit into the wood and cut out corners in the round hole. This is quite satisfactory when working in wood of proper texture, but in hard woods, it is difficult to feed the rectangular cutter into the material. An inventor has recently overcome this difficulty by using a bit with cutters that operate at right angles to the axis of the bit. These cut instead of crushing their way into the wood.

As shown in the view at the right hand side of the accompanying engraving, there is a cutter head mounted on the shank of the bit which carries the lateral cutters. These cutters are geared to the main shank. The cutter head is finished with a handle by which it can be kept from turning and may be adjusted to any desired angle. This view shows a tool for cutting square holes and consequently a square cutter head is used of a size just large enough to fit into the hole bored by the main cutter of the bit. However, other cutter heads may also be used which are three-sided or many sided and the cutters also may be varied in number and form so that a wide variety of patterns may be cut, ranging from an oval to a star in outline. In the view on the left-hand side of the engraving are shown some of the possible forms of holes that can be cut with a bit of this type.



Tool for boring holes ranging from an oval to a star, in outline

Reversing a Ship with the Rudder

THE ease with which ships can be maneuvered varies with the type, but everyone realizes that vessels cannot be handled simply, and a good deal of experience is necessary before one can become an expert. To carry out the comparatively simple operation of coming alongside a dock, there is often a large amount of backing and filling. Considerable attention has to be given to the reversing power of engines for this reason. Such power is most easily obtained from reciprocating engines; with turbines a special turbine must be installed for the purpose, and the more maneuvering power desired, the larger and more powerful and more expensive this turbine must be.

Even when all these arrangements have been made it is still not possible to give ships sufficient self-control under many circumstances in which they find themselves commonly placed. Tugs must be used repeatedly, and the demand on these vessels in all ports is great.

In our issue of September 28th last, we showed a unique arrangement for securing reversing ability. Instead of reversing the engine in order to make the ship run backward, there was a rudder so designed as to close in about the propeller and cause the flow of water from the screw to be so directed that the ship would travel stern foremost with the engines running normally. A British inventor now comes forward with what appears to be a more thoroughly worked out version of this idea. Instead of having his rudder in the form of two comparatively straight leaves which at best can only partially enclose the screws, he provides two cylindrical leaves, which can close completely around the screws from fore or aft, as is well indicated in the drawings which accompany this discussion.

The essential parts of the rudder consist of the two curved deflectors. These are pivotted at top and bottom on common centers. One is operated by means of a solid shaft, the other by a hollow shaft concentric with the solid one. By suitable mechanism the deflectors are made to turn together in the same direction or in opposite directions, so as to give a very wide variety of conditions. Some of the possible positions are shown in our cuts.

To be as effective as possible an ordinary rudder is placed in, or very near, the propeller race. This insures that the speed of the water passing over the rudder will be greater than the speed of the rudder itself through the water, by an amount which may

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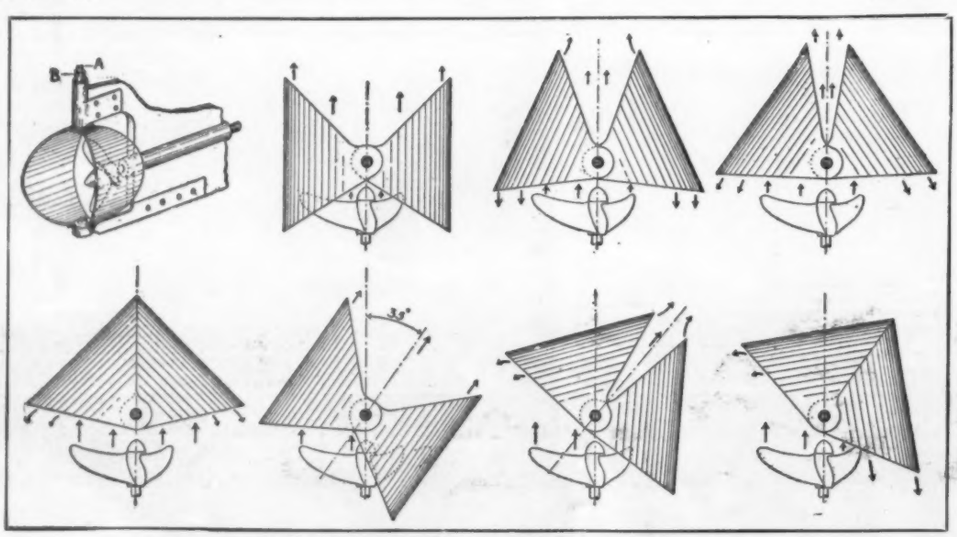

Typical positions of the reversing rudder members

Showing them set for full speed ahead (in pespective and in diagram from above); and in diagram from above when set for half speed ahead, for remaining stationary, for full speed astern (left, below), for full speed ahead to port (or starboard, to revolve the ship without progression, and for travel astern to port (or starboard).

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Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Elecitrcal Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

GROUND SPEED INDICATOR.—J. M. Gwinn, Jr., 7405 Burthe St., New Orleans, La. The primary object of this invention is to provide an instrument whereby the actual speed of an airplane may be determined and observed at any time irrespective of the direction or speed of the air currents or other conditions which would tend to confuse or disturb the operator of any speed indicating devices depending upon the speed of the machine with respect to the supporting medium or upon the behavior of the motive means which might be used.

Pertaining to Apparel

CONVERTIBLE SKIRT AND BREECHES.—C. D. Thoma, 149 W. 12th St., New York, N. Y. The invention relates to garments such as are worn by women or girls. It has particular reference to an interchangeable garment for use as either a skirt of walking length or as bloomers or breeches. An object is to provide fastening devices whereby in the transformation into the form of breeches the garment across the hips presents a wide military effect even though the skirt presents narrow hip lines.

Electrical Devices

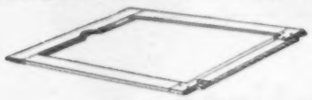
ELECTRIC FUSE.—F. I. Thiebaut, 1246 Alabama St., San Francisco, Cal. This invention relates particularly to a use in which a permanent holder is adapted to receive a fusible wire in a manner to permit of renewal of the wire as required—so that except for the fusing of the wire the life of the fuse may be perpetuated. An object is to provide a construction that will insure durability even under excessive heat and rough usage, and to insure the retention of the fuse wire in position.

ELECTRIC LIGHTING SYSTEM FOR AUTOMOBILES.—J. H. Wilson, care Hart Bros. Machine Co., Clarksburg, W. Va. An object of the invention is to provide an electrical distribution system primarily for automobiles which includes alternate sources of current, a generator or battery for supplying current to certain of the lamps in the system whether the engine is running or not, the distribution of the current being controlled by a master switch which is also one of the important features of the invention.

FUSE BOX.—A. A. Wells and H. B. Fife, 42 High St., E. Detroit, Mich. The invention has for its object to provide a fuse box with a cover it being possible to open the cover to permit the renewal of the fuses without danger of shock. When the fuses have been replaced resilient means serve to draw the cover into position where it may be closed by a hook which is also used to open the cover: upon closing the cover the fuses are automatically inserted in the circuits.

Of General Interest

KIT FOR PLATE HOLDERS.—F. E. Wood, Box 172, Sanger, Cal. The object of the invention is to provide a device to be used in connection with holders for photographic dry plates, for permitting the holder to be used with plates of



A PERSPECTIVE VIEW OF THE KIT

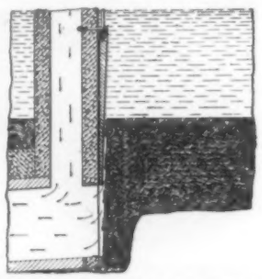
smaller sizes. The kit comprises a frame having one end slidably connected with the body of the frame to be pressed toward the other end, the slidable end and the other end of the kit frame having leveled edges to engage over the plates.

SNAP LOCK.—A. W. Prescott, 207 Water St., Binghamton, N. Y. The invention has for its object to provide a lock especially adapted for connecting the ends of sheet metal pipes and, fittings or for locking a seam of any character, wherein the arrangement is such that the seam can be instantly and permanently locked without the use of tools, and without the necessity of soldering or "setting down."

ENVELOPE.—G. L. Banks and O. B. Kirkpatrick, 1949 Bernard Ave., Los Angeles, Cal. The invention relates to envelopes for second-class mailing matter and is particularly adaptable for use by business firms having branches in different cities, such as insurance, and railroad companies, making it possible to use the envelope over and over again. An object is to provide a strong envelope which has a pocket for a removable address card, the card being secured during transit.

MOVING PICTURE PROJECTOR.—F. C. Taylor, address C. X. Frankhauser, 450 4th Ave., New York, N. Y. An object of the invention is to provide a simple and inexpensive moving-picture projector having an intermittent film-feeding device mounted on an oscillating frame the adjustment of which controls the framing of the picture. Another object is to provide a film gate with guide means at the upper edge which not only facilitates the engagement of the film with the gate but guides the film of the upper loop while the same is formed, before it is drawn through the gate.

SILT GATE.—W. Harris, Silver City, New Mexico. The object of the invention is to provide a construction whereby the bottom of a reservoir may be cleaned out of the silt substantially in an



SHOWING THE LOWER PART OF STAND PIPE AND GATE IN ELEVATED POSITION

automatic manner. A further object is the provision of a stand pipe and a drain off pipe together with a wedge-shaped gate, which when raised will leave an opening for starting the flow of water and thereby causing the silt to be washed through the drain pipe.

MEANS FOR FORMING CONCRETE PILES.—M. Miller, 485 E. 188th St., New York, N. Y. The invention has particular reference to means or methods of forming concrete piles either with or without metal reinforcement, with an enlargement either at the lower end or at some point above it, forming a footing or pedestal to increase the stability and the efficiency of the pile when built or sunk in soft earth.

FIRE HYDRANT.—R. H. Thorne and F. J. Miller, Williamsport, Pa. An object of the invention is to provide a fire hydrant of the inside cut-off type, wherein the main valve, the main valve seat and all other operating parts may be taken out after simply removing the cap at the top, the stand pipe or barrel of the hydrant having a bore of such a construction that there are no inwardly projecting parts to obstruct the removal of the mechanism.

DRINKING CUP.—V. E. Fermier, Forney, Texas. The invention relates to drinking cups and holders therefor, the object being to provide a small holder in the form of a case arranged to be conveniently carried and to hold and protect a paper drinking cup or holder of other material capable of being made impervious to moisture and of a foldable nature adapting the same to opening and collapsing movements with opening and closing of the case.

SOUND TRANSMITTING DEVICE.—E. Cherry, 1385 11th St., Oakland, Cal. The invention relates to a sound-transmitting device adapted to be carried by a partially deaf person for enabling sounds to be heard. The general object is to provide a device which is extremely sensitive to sound and also adjustable as to sensitiveness to suit the requirements of the user, this being brought about by a diaphragm chamber of adjustable size.

Hardware and Tools

TOOL BAG.—M. Miller and H. Golding, care Ellanger Corp., 135 Broadway, New York, N. Y. The object of the invention is to provide a tool bag more especially designed for the use of signal men in the army, repairers of machinery plumbers and other person and arranged to permit the user to readily carry the bag without danger of losing the tools or the sharp or cutting edges of the points of the tools in juring the carrier of the bag. The bag is capable of rough usage.

VULCANIZING TOOL.—C. T. White, Thomas Bldg., Santa Barbara, Cal. The general object of the invention is to provide a vulcanizer having a pressure foot so mounted relatively to the base of the vulcanizer as to accommodate itself to the various thicknesses of material being vulcanized and is adapted to be swung away from the base for the ready placing and removal of the material being vulcanized, the pressure foot is so formed as to constitute a fuel chamber having openings through which the fuel material may be lighted.

PIPE REAMER.—T. P. Salley, care R. A. Robsam, 122 Clarkson St., Brooklyn, N. Y. Among the objects of the invention is to provide an apparatus in the nature of an attachment for a standard type of pipe stock employed for the cutting of a thread on the outside of the end of a pipe, the attachment providing a simple means for finishing the end of a pipe ready for coupling and the passage therethrough of electric conductor wires or the like without obstruction.

Heating and Lighting

VACUUM BONNET.—J. H. Boyd, 142 S. 13th Ave., Mt. Vernon, N. Y. The invention relates to heating appliances and has for its object the provision of a removable bonnet or cap for a radiator valve formed with a spring seated structure which will become unseated for releasing air when the steam pressure brings the air under pressure, but it will automatically reseat itself when the steam pressure has been reduced.

Machines and Mechanical Devices

LAGGING STRETCHER.—J. W. Buller, Hillsboro, Kans. Among the principal objects which the invention has in view are, to facilitate the installation of a facing logging on pulleys or similar mechanical elements, to permit the operation of facing or covering a pulley without removing the same from service, and to provide portable apparatus for accomplishing the above stated object.

BUFFING OR POLISHING WHEEL.—A. Levett, 135 W. 79th St., New York, N. Y. The invention relates to buffing or polishing wheels made of cotton, wool, leather or other material. Its object is to provide such a wheel arranged to prevent the loss of the material of which the wheel is made and to permit of using the wheel until the material is worn away, practicaly down to the hub or center piece. Another object is to provide a wheel which can be manufactured with a minimum amount of material.

MEASURING DEVICE.—W. J. Brittain, Holdenville, Okla. The invention has for its object to provide mechanism for measuring liquids, as, for instance, gasoline, wherein a storage tank is provided, an air chamber, and a

A FRONT VIEW OF THE DEVICE WITH PARTS IN SECTION

measuring chamber connected in such manner that the liquid may pass from the storage tank to the measuring chamber and be discharged therefrom, and wherein a single valve is provided for controlling the movement of the liquid.

AUTOMATIC CHAIN-BELT-MAKING MACHINE.—J. Crowe, 2713 Duvean St., St. Joseph, Mo. The invention relates generally to machines for manufacturing chain belts, the device comprises link forming means, means for assembling the links to form a chain, means for forming traction blocks, means for inserting the traction blocks within the assembled links, and connections continuously operating to actuate the several parts, to form the complete belt.

Musical Devices

GRAPHOPHONE AND DISK RECORD HOLDER.—J. Heitman, Nome, Territory of Alaska. The object of the invention is to provide a record holder in which the records may be compactly and securely stored and kept, by which the removal of more than one record at a time is prevented, and in which a record once removed, must be replaced before another can be taken out, and in which, by means of a lever attachment all the records may be taken out.

Prime Movers and Their Accessories

SPARK PLUG.—F. F. Thomasson, 3824 Everett Ave., Oakland, Cal. A specific object of this invention is the provision of a spark plug which is formed with a head at its inner end that performs the double function of acting as a shield to prevent lubricant from being thrown on the electrode, and to act as shallow pan to receive a priming charge of gasoline whereby such charge is held in close proximity, say ½-inch to the igniting spark.

Railways and Their Accessories

LEG REST.—J. C. Brungard, 465 E. 50th St., North Collister, Wyo. The object of this invention is to provide a device especially adapted for use in railway cars, to be arranged between the seat of one chair and the footrest of the adjacent, to provide a rest for the legs, wherein the rest is capable of being folded into small compass and when extended offers a wide comfortable rest.

Pertaining to Vehicles

MOUNTING FOR FRONT WHEELS OF TRUCKS.—J. C. Sheler and R. B. Austin, 310 Marble St., Cadillac, Mich. An object of the invention is to provide a mounting for the front drive of a vehicle which will be simple and which will give a resilient connection between the mounting and the truck frame. With this device if any object strikes the front bar obliquely the tendency of the mounting would be to move on its pivot, thereby reducing the impact.

HEATER.—H. F. Koch, 30 Church St., care Kolb Portable Bldg. Co., New York, N. Y. The object of the invention is to provide a heater more especially designed for use in garages and are ranged to heat the radiator of an automobile to prevent freezing of the water during cold weather. Another object is to provide a heater which, when installed in a garage complies with the rules of the fire underwriters.

BELT ATTACHMENT FOR MOTOR VEHICLES.—F. R. Weisgerber, 725 So. 9th St., Salina, Kans. An object of the invention is to provide a strong and inexpensive attachment which can be easily applied to a motor vehicle and which takes the place of the crank and can be used in a manner similar to the crank. Another object is to provide an attachment which will not interfere with the vehicle and will allow the use of the vehicle with the attachment thereon.

WHEEL CARRIER FOR DEMOUNTABLE WHEELS.—W. F. Wahrenberger, care Ford Accessories Co., 585 Jackson Ave., Bronx, N. Y. Among the principal objects which the invention has in view are to provide a support for spare wheels on automobiles and particularly on the automobiles of the type known as "Ford." The carrier is provided with a hub journal block, which is adapted to fit the journal opening of a demountable wheel: the device may be attached to the running board or the rear of the car.

INDICATING VALVE.—G. A. Howe, Portland, Ore. This invention has for its object to provide a valve adapted for use in pneumatic tires wherein indicating mechanism is provided to show the pressure existing in the interior of the tire, and without the necessity for uncoupling the pump or air connection to asertain such pressure. The valve is self-registering numerals becoming visible showing the pressure in the tire.

TRANSMISSION.—E. M. and A. G. Ratburn, Sausalito, Cal. The inventors have been granted two patents, the objects of which are to provide a transmission especially adapted for motor vehicles, wherein the driving and driven shafts are connected by a fluid controlled mechanism, permitting them to be connected at any desired speed, wherein means is provided in connection with the transmission for converting into useful work that portion of the power of the motor which is usually wasted, when the driving and driven shafts are not directly connected.

Designs

DESIGN FOR A FLAG, PENNANT, SIGN, EMBLEM OR ARTICLE OF A SIMILAR NATURE.—O. F. Selle, 3248 Oregon Ave. St. Louis, Mo.

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contains Patent Office Notes. Decisions of interest to inventors—and particulars of recently patented inventions.

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A Car-Loader That Automatically Weighs the Load

OUR cover illustration this week illustrates an interesting system of transferring materials from ship to freight car, located at Locust Point in the harbor of Baltimore. Here there is a pier 800 feet long, on which there are three tracks. The center track is provided with a conveyor belt 30 inches wide, which extends the entire length of the pier. This is driven by a motor located in an operating house at the land end of the pier. On this central track runs a loading machine and a series of hopper cars. On each side are tracks on which freight trains may be run to be loaded by the loading machine. Heretofore it has been customary to move cars up to the loading position, but with the present system the loading machine travels along the line of cars and will deliver its load to any desired one. The hoppers are loaded in the usual way from vessels or lighters and they have a capacity of 20 cubic yards of material. This material is delivered as required to the conveyor belt.

The loading machine is provided with 20-inch belt conveyors which pick up the material from the main conveyor belt, pass it through a weighing machine and deliver it to a loading arm, which in turn delivers it to the car. The loading machine will operate to load either an open or gondola car or a box car. When the loading machine has been moved to a proper position, the loading arm is introduced into the door of the car and then may be swung to any desired angle to deliver its load. The loading arm has a horizontal travel of 270 degrees and also can be moved vertically so as to be raised above the highest open car.

The entire operation is under control of the operator located in a cabin on a loading machine. Power is supplied to the machine by means of wires strung along the bulkheads, which separate the middle track from the outside tracks. The hopper cars are provided with motor drive so that they may be moved to any desired position. With this equipment, bulk materials such as ores, sulfur, clay, coal, etc., may very quickly be transferred from a vessel to a freight train. With this loading machine box cars have been loaded in ten minutes and gondola cars in less time.

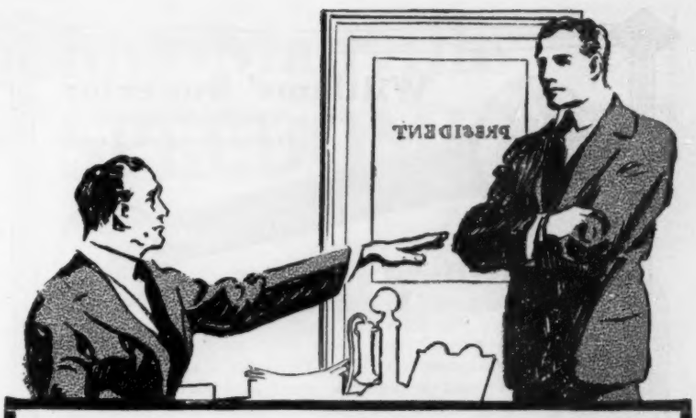
One of the most interesting features of the system, is the electric weighing apparatus, details of which, were published in the SCIENTIFIC AMERICAN of August 10th, 1918.

Our Navy's Bid for the Great Trans-Atlantic Flight

(*Continued on page 479*)

practically the same as those given for the NC-1. However, aside from being faster, these more recent boats are remarkable climbers, being able to make 3,000 feet in less than 10 minutes. Depending on the load and other conditions, they can take off from 30 seconds to slightly over a minute.

It is interesting to study weights in connection with the attempted flight. The total weight of the more recent NC planes is about 16,000 pounds. The gas and oil for the great flight weighs 11,500, and the crew of five about 900 pounds. The total useful load possible is figured at about 13,000 pounds, giving a gross load of 29,500. The limitations of the load has led some Navy men to conclude that the Azores route from Newfoundland is practically the only one available, although nothing has been officially said about the matter. The distance from Newfoundland to the Azores is some 1,200 miles, while to Ireland the distance is 1,760 miles. At a fair rate of speed, the flight to the Azores should take about 17 hours, while to Ireland it might take 27 hours. Now then, the four Liberty engines require 650 pounds of fuel an hour at cruising speed, which on the Azores course would mean about 11,050 pounds, and on the Ireland course, 17,550 pounds. For a non-stop



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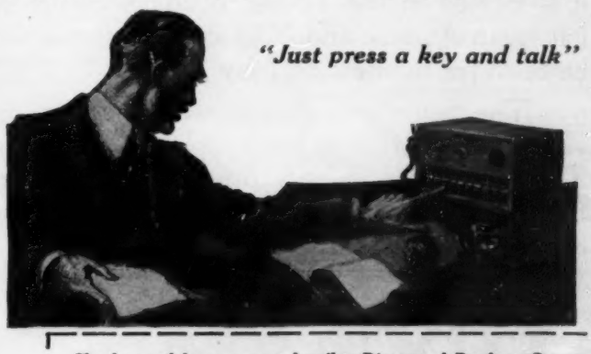

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flight between Newfoundland and Ireland it would require a gross load of 33,550 pounds, which is obviously beyond the capacity of the NC boats. Of course, these figures apply to a non-stop flight, and if a stop could be made in mid-Atlantic for the purpose of recharging the fuel tanks, the Newfoundland to Ireland course would at once be a simple matter in so far as fuel is concerned.

It is understood that the trans-Atlantic flight will be undertaken by three Navy planes—the NC-1, NC-3 and NC-4. The NC-1 was partially wrecked in a gale, and is now being refitted for the trans-Atlantic flight. The NC-2, which had four engines arranged in tandem pairs, proved unsatisfactory, and has been dismantled; in fact, the wings of this plane which are in good condition are being used for the reconstructed NC-1.

The one advantage which the small Sopwith and Martynside machines possess, namely, ability to get to the starting point first and getting away at the earliest possible moment, appears to be more or less gone now that the U. S. Navy has its huge NC boats about ready. And when it comes to a race between the small and large machines, everything except speed is in favor of the later. And in a contest of this kind speed is not the first consideration, for it will be a truly remarkable achievement if the single-engined planes succeed in making the ocean crossing. On the other hand the large Navy planes, with at least one engine of each plane in reserve in event of engine failure, have everything else in their favor: there will be no navigational difficulties, even if dense fog is encountered, because of the directional wireless and the string of ships along the route; help will be available at any point along the route; the multiple-engine equipment will ensure reliable performance; and the perfect boat body of the aircraft will permit of landing on a fairly rough sea and making any necessary repairs.

Truly, this trans-Atlantic flight competition has now resolved itself into a contest between sportsmen on the one hand, and engineers on the other. The first depend on luck, more than anything else; the second depend on preparing for all contingencies. But even with the most thorough preparations, such as our Navy has carried out, the attempt is still a difficult one, and much still depends on what we are pleased to call luck, for want of a better word.

The Tank Man's Story

(Continued from page 482)

how easily they run. You can crawl over a telegraph pole and hardly feel it, so well worked out has been the spring suspension, the relation of rollers, chariots and treads. And they didn't go in for any fancy touches, the Renaults. No armor for the guns nor fancy locks on the door to keep some one from crawling up and throwing a grenade inside, nor deflection armor at odd angles which never did anything but stop bullets and make splinters that otherwise would never have endangered any one's eyes.

"German tanks? Punk. Too slow, mechanism too exposed, too many slits. Oh, very well made, but poor design. Nor do I think very much of German tank men.

"We had about 44 per cent casualties, and that covers 22 actions. Ten per cent of the casualties were deaths. But I don't recall many men dying without doing something first.

"I recall that there was one tank got stuck in a trench and nothing handy to rescue it. Captured, of course. Well, we captured it back two days later. Every round of ammunition was fired. Every pistol cartridge had been fired. And both men had been wounded long before they were killed; there was plain evidence of it in blood where no blood would be if they had just been snuffed out right at first. They must have put up a beautiful scrap. Americans don't like to surrender, somehow."

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Free as Air

(Continued from page 484)

such numbers to be recognized. Yet flying high is the greatest safeguard an aviator has. Apparently the solution of the problem is a prescribed course for airplanes between any two points, and yet this has difficulties, since wind and fog might easily make a plane fly out of its course. No law holds the individual responsible for those things he is compelled to do by act of nature. How shall responsibility be affixed to the operator of aircraft which loses some part of its mechanism when driven over a residence by a storm, said part of the mechanism doing damage below?

In view of the hundreds of legal questions here but outlined, some attempt at settlement should be made at once. It is not a matter for legislation without investigation, yet such an investigation can hardly be made authoritatively by private organizations without governmental cooperation and sanction.

The development of civilization has been essentially the development of transportation. The airplane and the dirigible and such other instruments of aerial navigation as the future may bring forth (the helicopter, for instance) will do more to annihilate distance and decrease the difference in time between town and town than train, automobile, public road and steamship together have done.

Until the war forced it forward, this country which gave birth to the airplane, was extremely backward in the development of aerial transportation. Today we have a great industry and thousands of fliers. These must result in a development of aviation worthy of America. But the legal aspects of the matter may kill it, as ignorance and inertia killed its development here prior to the war. It is very much "up to" all interested, to see to it that people are educated to the possibilities and the needs of legislation, and that the Federal government wait not too long in establishing an investigating committee which shall report along the same lines as similar committees have investigated and reported in France and England and Italy.

The economic future of the world may well depend upon the development of aviation. Are we going to be short-sighted enough to let our part in it like Topsy, "just grow" or will we take action in time, and see that our legal enactments and control be such as to further and not hinder the progress of that art-science which holds no little promise for the spread and increase of civilization?

Shale Oil as a Business Proposition

(Continued from page 484)

There will be ammonia and potash from the residues. And there will be other items, but as to just what they will be, and how much of them will be recovered, no two authorities agree. Estimates of the aggregate value of all products run as high as $15, $20, in one case even $45, per ton of raw shale—and as low as $3 per ton. Cost estimates range anywhere from $1.25 to $10 per ton.

The shale industry has been demonstrated, as to process, values and profits, in Scotland these many years; but that doesn't prove anything about the United States. We do not yet know how our shale compares with Scotland's. We suspect that much of it is richer in oil; but it may be found leaner in other products that go to make up the profits. Then mining conditions are totally different in the two countries. The Scotch shale has to be brought up to the surface; ours has to be blasted out of immense cliffs. On the face of it, ours should be the cheaper process; yet one may well doubt that we shall be able materially to reduce the Scotch mining costs of 40 cents per ton; and after we get the shale out of its bed, our costs will be greater.

All this goes to show two things. It goes to show that, in the first place, the

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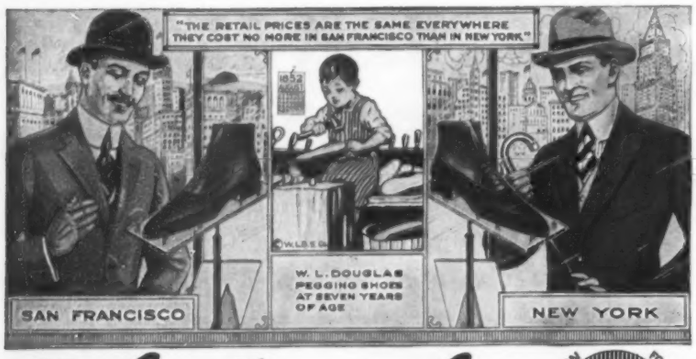
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American oil shale industry is still in the experimental stage. Now there are a lot of American manufacturers who will testify that there is money to be made in the laboratory; but the men who make it are the ones who finance the laboratory work, and not those who supply the raw materials. The turn of the latter comes only when the processes developed in the laboratory come into the general market for the use of everybody, either through license or expiration of patents. Nobody is going to get rich because he owns oil shale lands, until after the chemists and the engineers have finished their end of the contract—and to date they have hardly begun.

The second Q. E. D. of the oil shale industry is that it is a big man's game. There are no gushers here that bring in millions in a few weeks; and there are no dry holes that eat up the money without giving the investor a chance of return. Shale oil is not a gamble, it is not a small prospector's game, it is not a game for the man with a home-made plant working on a small scale. It is a big manufacturing proposition, involving plentiful supply of raw material, plant operation on a large scale, and marketing problems. It is a business where, after the experimental preliminaries have been closed out, you invest millions to get back a reasonable return, and a sure one. It is no game for the little fellow, and the only place where the little fellow can get in on it is by buying and holding shale lands until the big fellow is ready to buy him out.

Another thing—shale oil is not going to run the oil-well man out of business—at least, not in this generation. The quantity of oil shale exposed on the surface and easily accessible is practically inexhaustible. There is enough in the four states mentioned to provide all the raw shale that can be treated for the next century. But take the most optimistic cost figures that have been presented, and stop to reflect that to get a shale-oil production equal to one-ninth the present output of the wells would call for a capital investment of $30,000,000; while under the least favorable estimates, this production would necessitate the finding of $250,000,000. We shall not get the technical problems of shale distillation worked out, and we shall not get our capitalists convinced of the practicability of the shale-oil business on any such scale as this, for many years.

The true status of the shale industry may be verified if we look carefully into the attitude of the Bureau of Mines. The impression seems to have got abroad that this Bureau is in a state of roaring optimism regarding the immediate prospects of the shale deposits as a millionaire factory. Nothing could be further from the truth. The Bureau has deliberately refrained from issuing reports upon the various methods now known for recovering oil from shale, simply because so little is known in this country on the subject. Moreover, the Bureau, when it has had the opportunity to advise investors contemplating entrance into this field, has always pointed out that the industry is in the experimental stage.

On the other hand, the Bureau is properly optimistic with regard to the ultimate future of the industry. It has, through one of its engineers, been lending technical assistance to the construction of small experimental plants at various points. It has two engineers engaged in studying the oil shale possibilities in this country, and two others who have recently examined the Scotch industry in considerable detail.

The final word of the Bureau, is that the incipient boom in oil shale properties which is now under way in the West is one calculated not only to lead to considerable direct loss, but equally, through undermining of public confidence, to serious delay in the progress of the industry.

Our Marked Highways

(*Continued from page 487*)

either side of the track. In riding into a Missouri town on the Pike's Peak Ocean-to-Ocean Highway we found that our marks halted abruptly. It was too early for natives to be abroad, so, mindful of the usual small-town custom, we ventured to turn to the left and drive through the village along the main street. Finding no guide marks to be picked up when we got out of town, on the other side, however, we returned; and there was our original course, plain as day, to the right and across the railroad tracks. When we were there the first time a long freight train had been halted at just the right spot to hide the marker beyond. A marker close to the track on our side would have obviated the difficulty.

The Seagull Flies

(*Continued from page 489*)

There is another very important member of this aerial ship's crew. The observer, sitting in the little cockpit in the very nose of the plane, surrounded with all manner of strange looking instruments, has quite a few duties to attend. He is a radio operator and can send and receive radio messages to and from his station on shore. He makes known his position from time to time and reports anything sighted of an interesting or suspicious nature. It is he who trains the bomb sight on the enemy submarine, the sight automatically indicating to the assistant pilot behind, the proper moment to release his bombs. In some cases he has a Lewis gun or a Davis non-recoil gun combined with a Lewis gun tracer mounted on the scarf-ring around his cock-pit. This latter contrivance is very ingenious. The bullets from the Lewis gun make splashes in the water about the target and indicate when the gun is pointed directly on the target for a direct hit. When the Lewis gun bullets are hitting the target the Davis gun is discharged and a fair-sized shell finishes the job. This combination doubtless accounted for quite a few German subs.

The big factor of all aircraft is the motor. In the event of motor trouble the land flier is always assured of a place to land. He may land in a tree or in a plowed field, but he usually comes out of it all right. His worries are over when his feet touch the ground. The naval flier has another element to contend with, the sea. Even if he does not crash on landing in a rough sea, the prospect of drifting about, pitching and tossing for hours, perhaps days, is not one to look forward to with any amount of pleasure. A flying boat on the water does not make an object easily seen or distinguished, especially if a sea is running. The chances of being picked up, if far at sea, are pretty slim. The chances were much better in the submarine zone abroad than in home waters. Submarine patrol was far more risky on the American coast then abroad for this very reason. The submarine zone fairly swarmed with craft hunting for the Boche serpent. At home the ships were few and far between.

Many tales are told of long drifts in a wrecked plane before rescue came about. It is nothing like drifting in an open boat. The open boat is at least designed to withstand a sea, the flying boat hull is not. Its one-eighth-inch planking does not hold together long, especially if subjected to a bad landing. The water soon finds its way into the cock pit for the fliers to slosh around in until rescued. It is usually the airfilled wings that keep the wreck afloat at all.

These pages could be filled with tales of naval pilots drifting helplessly at sea for hours and days until picked up by a steamer or submarine chaser. In many cases the pilots were obliged, on being picked up in southern waters, to take involuntary trips to the north, or vice versa. They would be taken perhaps thousands of miles from their home station, not being able to get ashore until the next point of embarkation was touched by the boat. I remember one case in which so many of these ocean trips were figured in by the same pilot that a suspicion was raised on his station as to whether he did not take a keen enjoyment in these impromptu ocean voy-

ages and used them to vary the monotony of a naval aviator's existence.

There is no sarcasm in that expression. The naval aviator's life is indeed monotonous, even his flights do not give the thrill that is supposed to go with flying. To fly for hours in a grey void if the weather is foggy or misty, the water scarcely discernable and only distinguished by the breaking crests of white caps. If the weather is fine, the blue of the sky blends into grey where the horizon ought to be and the grey merges into the greenish-blue of the ocean. Seldom are the days when the line of the horizon is clear and sharp. About the most interesting things to the pilot are his instruments arrayed on the dash before him, and Lord knows they are monotonous enough.

A passing ship breaks the deadly sameness. Flying low, you survey the deck and peek into the port holes. The crew and passengers rush up from below and wave you a greeting. Great is the temptation of a forced landing and the ensuing ocean voyage.

Or you come upon a convoy starting abroad with its load of khakied enthusiasm. Then, indeed, you have something to look at. There is something, enough to stir the most sluggish spirit, in the spectacle of ten or fifteen transports fringed about with bristling cruisers and with destroyers darting about like minnows playing around a school of larger fish. Each craft leaves its own trail of white, widening out behind and fading into green again. The convoy has its special detail of many planes and "blimps." Their eyes will take care to the subs which are bold enough to attempt a sinking in the face of all this protection. We are out for the raiding sub that prowls up and down the coast looking for no particular prey but destroying anything that could be called a ship and having for an object the terrorizing and weakening of the morale of the people at home.

True it is, few are the subs you do sight. Your heart gives a thump as you sight your first one. Carefully you steal upon it and already you see headlines in the newspaper and a war decoration. You would think he would dive and wonder why he does not at least make an attempt to escape. Now you are on it, one well-placed bomb will do it. But wait, not so fast. See those markings. Disgustedly you swing back to your course. Instead of decorations you see headlines and disgrace for sinking one of your own submarines.

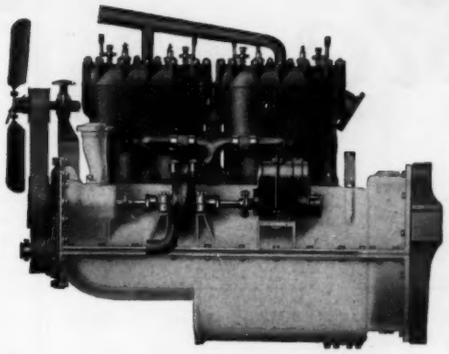
But even though you do not sight enemy undersea craft, they may have sighted you while they were in the very act of creeping upon their unsuspecting victim. Your very presence has averted a sinking. How often did the entry appear in a captured submarine's log: "Hostile aircraft sighted. Forced to submerge."

Recent Novelties in Public Speaking

(*Continued from page 489*)

cable, and all the wiring leads to a central point where the necessary connections can be made. Thus a speaker either on one of the stands on Victory Way or in an airplane several thousand feet aloft, can address the thousands of persons gathered along the avenue, through the battery of loud speakers.

Vacuum-tube amplifiers figure largely in the operation of such a vast number of loud-speaking telephones. Each amplifier unit is nothing more than an incandescent lamp of very much the same design as those used for illumination, but is provided with two or more electrodes inserted in the bulb along with the filament. Such an arrangement constitutes a very delicate electrical relay; that is to say, a very weak electric current may be used to modulate or affect a far more powerful current, thus building up any weak current to any desired strength. In fact, such amplifiers are used in long-distance telephony, one amplifier being employed for every 500 miles of transmission. By passing a weak current through one amplifier circuit, and permitting that circuit to affect a second



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circuit, which in turn affects a third circuit, and so on, the weak current can be used to modulate a loud-speaking telephone circuit of almost any magnitude. Commercial six-step amplifiers are in regular use, with amplifying qualities said to be in the neighborhood of 1,000,000 times. To the layman it is practically impossible to imagine sound amplification carried to that degree, yet it is regularly done.

For the purpose of receiving speeches from airships and airplanes, Victory Way has been spanned by a huge aerial. The currents induced in the aerial are led to a wireless receiving set which, in turn, modulates the loud-speaking telephones through a multi-step amplifier. The same equipment has been readily employed for receiving speeches from Washington, Chicago, or other cities within ordinary telephonic communication of New York City.

Reversing a Ship with the Rudder

(*Continued from page 492*)

become as great as 30 per cent. It also insures that in starting the ship from rest there will be a flow of water over the rudder, giving steering power before the ship has much way.

The power of the rudders unaided to drive the vessel astern without reversing the engines renders it possible to dispense with all other reversing mechanism. The contingency of the rudder's being out of commission need not be provided for to the extent of installing a second means of reversing, since with the rudder inoperative the vessel is helpless, anyway. In reciprocating engines this means that the link motion, reversing engine and astern guides can be left out, while with the turbine installation there is no need to fit astern turbines. With oil engines the reversing rudder actually eliminates uncertainty in the operation of the reversing mechanism, and substitutes certainty therefor.

The rudder here shown has been thoroughly tried out up to 150 horse-power by the British Admiralty and others. Extensive trials have shown that there is no loss of speed ahead in boats thus equipped. The speed astern is about one-third of that ahead, being perhaps a trifle less than the astern speed ordinarily obtained by reversing the direction of the propeller.

Effects of Attachments on Quality of Work and on the Draft of Plows

(*Continued from page 490*)

There are few times when a plow, either walking, sulky or gang, should be used without the jointer. It is decidedly necessary in plowing sod. Some farmers have gained the impression that a rolling coulter takes the place of the jointer. It does not and cannot do what the jointer is meant to do. The jointer is a decided help in turning under trash; it effectually prevents the growth of grass between furrow slices; and it leaves the ground in better condition for other tillage tools. Some claim that the use of the jointer saves one harrowing. In addition to these benefits, it decreases the draft, as the figures show.

Various types of cutters are used on walking plows. They all assist in making a clean-cut furrow bank possible and the use of many of them results in decreased draft. The rolling coulter is most generally used on sulky and gang plows. Although the figures herewith given show that it increases the draft, its use in cleanly cutting off the furrow slice and in cutting through trash overcomes any disadvantage due to greater draft. Manufacturers of plows almost invariably equip their sulky plows with coulters rather than jointers. This is a great mistake. If only one attachment is used, it should be the jointer, except under unusual conditions.

The ideal combination is the coulter and jointer. These may be used as separate attachments or as a one-piece attachment. The latter has been developed chiefly in connection with tractor plows, but is used quite widely on sulky plows.

The beam wheel on walking plows should be regarded as a valuable attachment.

The following table shows in a striking way the effect of the jointer, the rolling coulter, and the combination coulter and jointer on the draft of a sulky plow. Each series is the average ot 10 tests. The general average, therefore, is the average of 40 tests. The tests were all made in a clay loam soil which was covered with a rank growth of timothy. All conditions were made as uniform as possible. The figures represent the total pull in pounds. Not all furrows were of exactly the same size. In order to have results comparable, therefore, it was necessary to reduce all pulls to pounds per square inch of furrow slice, that is, the total pull divided by the cross sectional area of the furrow. This figure was then used in connection with a common furrow eight inches deep and 14 inches wide, in order to have all pulls comparable. The average furrow cut was approximately of these dimensions.

EFFECT OF ATTACHMENTS ON THE DRAFT OF A SULKY PLOW

Series	Plow Attachments			
	Bare	Jointer	Rolling Coulter	Combination Coulter & Jointer
1	628	654	707	769
2	647	589	688	725
3	616	603	663	805
4	649	595	682	725
Average	635	610+	685	756

The Manufacture of Carbon Electrodes

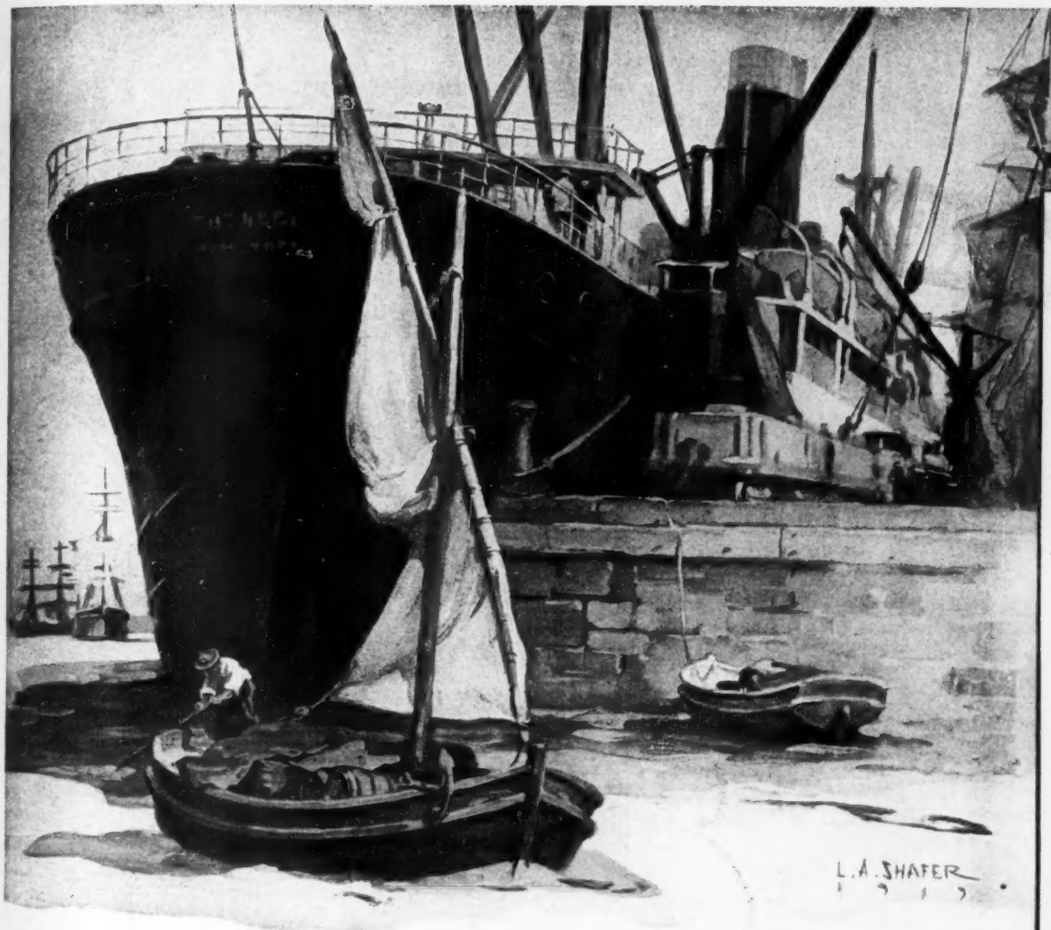
(*Continued from page 492*)

stances precedes this step. The mixed material is then pressed, sometimes in extremely powerful presses, to the size and shape desired in the finished electrode. There follows a baking or roasting of some sort to drive off the volatile elements and reduce the mass to the carbon form sought.

Although amorphous carbon electrodes have for some time been obtainable from non-German sources, their manufacture has presented some few difficulties. In order to avoid ruinous local stresses, the work calls for extremely uniform temperatures throughout the heating chamber, temperatures varying from 450 to 600 degrees Centigrade; and these must be maintained for such long periods and with such accuracy that the use of any other than a gaseous fuel is out of the question.

We have been shown a furnace developed for this work by a leading British firm of heat engineers. This furnace is installed in a large Midlands steelworks, with an output of 30,000 tons of electric steel per year. It is constructed of a special refractory material, with walls nine inches thick, bound by channel irons and tie rods. The heating chamber is designed to accommodate six electrodes at a time, of any size up to 22 inches in diameter. The top of the furnace, or cover-plate, is of box section, and serves as a preheater for the air supply taken in by the burners.

The latter, as will be seen in our illustration, are of the fan-air type, for consuming town gas at a slight supplementary air pressure of about six inches water column. It will be seen that the nozzle, the part that in any type of burner requires most frequent renewal, is formed of a refractory block, which can be easily and cheaply replaced. Each of the six burners attached to the furnace has a 1¼-inch gas-supply pipe and a 2½-inch air supply, separate main controls being provided for both gas and air, while the permanent air rate of the burner can be adjusted by manipulation of the regulating plug. Three burners are placed at each side of the furnace, firing into combustion chambers 12 inches wide and five high, placed underneath the floor of the heating chamber, and of such size and shape as to insure complete combustion of the gas and air therein. The burners fire alternately from either side to insure an even distribution of heat.



"Can you guess who I am?"

How World-encircling Steamship Companies make sure of Scientific Lubrication

"CAN you guess who I am?" The visitor was the first man to come over the side of a tramp steamer which recently stopped at Buenos Aires.

The engineer replied, "I haven't met you before. But if I were to make a guess from my experience in the world's principal ports I should say you are a Vacuum Oil Company Representative."

He was right.

Steamship companies lay great stress upon securing correct lubricants of guaranteed uniformity at all ports of call.

To meet this world need, the Vacuum Oil Company maintains stocks of Gargoyle Lubricants at every port of importance on the globe.

The steamship owner knows that Gargoyle Lubricants he secures at Delagoa Bay, Bilbao, Hong-Kong or Dundee will be identical with those he started out with from his home port.

Gargoyle Lubricants for marine use include all lubricants for gas and steam engines, Diesel engines, dynamos, turbines, propeller shafts, bearings and other lubricating needs. To these are added such specialties as Gargoyle Storm Oil to quiet stormy waves and Gargoyle Vaclite, a solid fuel which gives a smokeless and odorless white flame in the ship's bunker lamps.

The world-wide supremacy of these Gargoyle Lubricants and specialties is absolute. And—The work must go on.

GARGOYLE

Lubricants

A grade for each type of service

Correct Automobile Lubrication

GARGOYLE

Mobiloils

A grade for each type of motor

Gargoyle Mobiloils for engine lubrication are

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil Arctic

The Chart below indicates the grade recommended by the Vacuum Oil Company's Board of Engineers. The recommendations cover all models of both passenger and commercial vehicles unless otherwise noted. If your car is not listed in the partial Chart, send for booklet "Correct Lubrication" which lists the correct grades for *all* cars.

AUTOMOBILES	1913 Models		1914 Models		1915 Models		1916 Models		1917 Models	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Auburn (4 cyl.)							A	Arc	A	Arc
Auburn (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Auburn (6-38)					A	Arc	A	Arc		
" (6-39B) Tractor-11			A	Arc						
Autocar (2 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Briscoe	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)							A	A		
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cadillac (8 cyl.)	A	A	A	A	A	A	A	A	Arc	Arc
Case	Arc	Arc	Arc	A	Arc		Arc	Arc	A	Arc
Chalmers			A	A			Arc	Arc	Arc	Arc
" (6-40)							A	Arc		
" (6-50)	A	A			A	A	A	A		
Chandler 6-55	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (E cyl.)		A	A	A	A	A				
" (F A)	A	Arc	A	Arc						
Cole							Arc	Arc	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A	A	A
Cunningham									Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A		
Dort	Arc	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
" (Model C)					A	Arc	A	Arc	A	Arc
" (2 and 3½ ton)	A	A	A	A						
Dodge Brothers	A	Arc	A	Arc	A	Arc	A	Arc	E	E
Dort	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Federal	Arc	Arc	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod. 5-3C)			A	A	A	A				
Federal (special)			Arc	Arc						
Fiat			B	A	B	A	B	A	B	A
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	A	A	A
Grant	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
" Com'l	Arc	Arc								
" (Model 12)	A	Arc								
Haynes	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A		
Hudson							Arc	Arc	Arc	Arc
" Super Six	A	Arc	A	Arc	A	Arc	A	Arc		
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Kelly Springfield	A	A	A	A	A	A	A	A	A	A
King									A	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A	Arc	Arc
" Commercial			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Kissel Kar	A	Arc	A	Arc	A	Arc	Arc	A	A	Arc
" " (Model 48)							A	A	A	A
" " (12 cyl.)			A	A	A					
Lexington	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Lippard Stewart			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" " (Mod. M)					A	Arc	A	Arc		
" " (Mod. MW)					A	Arc				
Locomobile	A	E	A	E	E	E	E	E	E	E
McFarlan			A	Arc	A	Arc	A	A	A	Arc
Madison			A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)					A	A	A	A		
Marmon	A	A	A	A	A	A	A	A	A	Arc
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	A	A	A	A	A	A	A	Arc	Arc
" (22-70)									Arc	Arc
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)							A	A		
Moline-Knight	B	A	B	A	A	A	A	A	A	A
Monroe			A	Arc	A	Arc	E	E	A	Arc
" (Mod. M4)			A	A	A	A				
" (Mod. S)	A	A								
Moon			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mush	A	Arc	A	Arc						
" (Mod. 671)			A	A						
" (Quad)	A	A	A	A						
National	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A		
Nelson	A	A	A	A	A	A				
Oakland	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)							A	A		
Oldsmobile (4 cyl.)	A	Arc					Arc	Arc	Arc	Arc
" (6 cyl.)	A	A	A	A	Arc	Arc			Arc	Arc
" (8 cyl.)	A	A	A	A			A	A		
Overland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Packard									A	Arc
" (12 cyl.)	A	A	A	A	A	A				
" Commercial	A	A	A	A	A	A	A	A	A	A
Paige (4 cyl.)									A	Arc
" (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (6-36)							A	Arc	A	Arc
" (6-38-50)			A	Arc						
" (6-40)	A	Arc	A	Arc						
Paige (Com'l)	Arc	Arc	Arc	Arc						
Paterson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Peerless			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A		
Pierce Arrow	A	A	A	A	A	A	A	A	Arc	Arc
" " Com'l	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	Arc	Arc	Arc	Arc
Regal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)							A	A	Arc	Arc
Renault (French)							A	Arc	A	Arc
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Riker	A	E	A	E	E	E				
Saxon	E	E	E	E	E	E	E	E	E	E
Selden	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (3½ ton)					A	Arc				
Simplex Crane			A	A	A	A	A	A	Arc	Arc
Stearns-Knight	B	A	B	A	A	A	B	A	B	A
Studebaker	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Velie (4 cyl.)									A	Arc
" (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (2 & 3½ tons)	Arc	Arc	Arc	Arc						
" (3½ tons)	A	Arc	A	Arc						
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Sixteen Valve)	A	A	A	A	A	A				
White (3 ton)	A	A	Arc	Arc						
Willys-Knight	B	A	B	A	A	A	B	A	B	A
Willys Six	Arc	Arc	Arc	Arc	Arc	Arc				
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

COLGATE'S

"HANDY GRIP" PATENTED 1917

The only Refill Shaving Stick

—"like putting a new bulb in a socket"

Save the "socket" of your Colgate "Handy Grip"—you don't need a new "socket" with every new shaving stick, any more than you need a new socket with every new electric lamp.

You can use a Colgate "Handy Grip" for years by refilling it when necessary with a new stick, just as you'd refill a lighting socket with a new lamp. The "Refill" stick is threaded to screw in just as the original stick did.

Double economy with Colgate's. The Refill costs less than the complete "Handy Grip." Even the stub unscrews from the old "Handy Grip"—is easily mounted on the Refill and adds 50 more shaves.

Mount the old stub on the new Refill

Some men still prefer to shave with a Cream though it is the least economical way. To these men, this friendly word: Clip this paragraph and mail to us before July 9th. We will send you, free, a trial tube of Colgate's Perfected Shaving Cream. You cannot be sure you know the best till you have used Colgate's. But we give you the impartial advice to use the "Handy Grip" as the most convenient and economical way to shave. We can do this impartially as we make all three forms of shaving soap—Stick, Powder, and Cream.

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